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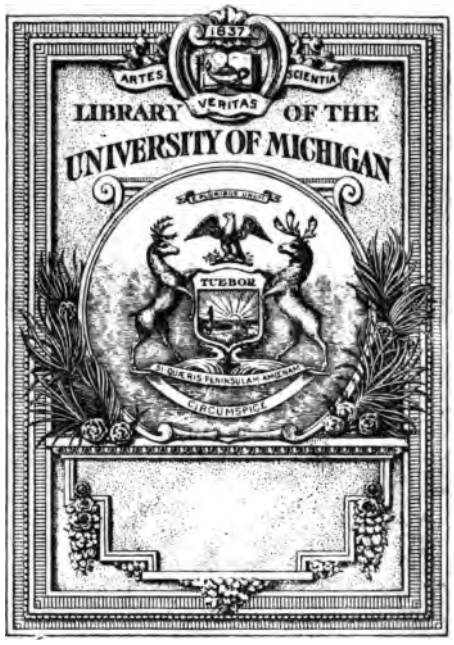

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MEMOIRS

OF THE

WERNERIAN NATURAL HISTORY SOCIETY,

FOR THE YEARS 1824–5.

VOL. V.
PART II.

WITH TEN ENGRAVINGS.

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ADVERTISEMENT.

In laying its Memoirs before the Public, this Society does not hold itself responsible for the facts or opinions which may be advanced on the various topics of Natural History that are discussed. These, accordingly, must be distinctly understood as resting entirely on the individual authority of the respective Writers who have favoured the Society with Communications.

XVI.—*On some Fossil Shells found in the Gawilghur Range of Hills, in April* 1823.

By H. W. Vaysey, Esq.
Surgeon to the Trigonometrical Survey, East Indies.

(Communicated by Sir James Macgrigor, President of Army Medical Board.)

(*Read 6th March* 1824.)

THIS remarkable range of hills is called by Arrowsmith, in his last map, the Bindeh, or Bindachull Hills. The same name is, however, given to a lofty range of hills on the left bank of the Godavery, as it passes through Goudwana, and also to those near Gualior. I shall therefore distinguish them by the name of the Gawilghur Range, particularly as, after repeated inquiries, I have never been able to discover that they were so designated either by the inhabitants of those hills, or of the neighbouring plains. They take their rise at the confluence of the Poorna and Taptee rivers, and, running nearly E. and by N., terminate at short distances beyond the sources of the Taptee and Wurda. To the southward they are bounded by the valley of Berar, and to the north by the course of the Taptee. The length of the range is about 160 English miles, and average breadth from 20 to 25 miles.

On the south side, they rise abruptly from the extensive plain of Berar, the average height of which is 1000 feet above the level of the sea, and tower above it to the height of 2000 and 3000 feet. The descent to the bed of the Taptee is equally rapid, although the northern is less elevated than the southern side of the range. The outline of the land is generally flat, but much broken by ravines, and by groupes of flattened summits, and isolated conoidal frusta. The summits and the flat land are for the most part remarkably destitute of trees, but they are thickly covered with long grass. In the ravines and passes of the mountains the forest is very thick, and in many places almost impervious. The inhabitants are principally Goauds, whose language, manners and customs, differ remarkably from those of the Hindoos. At present their chief occupation is hunting, and cultivating small patches of land, which produce a coarse rice and millet. In former years the cultivation must have been very extensive, since there are the ruins of numerous hill-forts and villages, which derived their chief subsistence from the surrounding lands. Many opportunities are afforded of studying the nature of this mountainous range in the numerous ravines and precipitous descents which abound in every part. A Wernerian would not hesitate in pronouncing them to be of the newest floetz trap formation; a Huttonian would call them overlying rocks; and a modern geologist would pronounce that they owed their origin to submarine volcanoes.

I shall not give them any other name than the general one of Trap-rocks, but proceed to describe them, and state, with diffidence, the inferences which I think obviously present themselves, on an attentive study of their phenomena.

1. The principal part of the whole range is formed of compact basalt, very much resembling that of the Giant's Causeway. It is found columnar in many places; and at

Gawilghur it appears stratified, the summits of several ravines presenting a continued stratum of many thousand yards in length.

2. The basalt frequently and suddenly changes into a wacke of all degrees of induration, and I may say of every variety of composition usually found among trap-rocks. It changes,

3. Into a rock, which may be named indifferently Nodular Wacke or Nodular Basalt, composed of nuclei of basalt, usually of great specific gravity, surrounded by concentric layers of a loose earthy mass resembling wacke, but without cohesion, which, on a superficial view, conveys to the mind every idea of a fluid mass of earth, having in its descent from some higher spot involved in its course all the rounded masses it encountered, and subsequently became consolidated by drying. A very slight inspection is sufficient to detect the true cause of this appearance, which is owing to the facility of decomposition of the outer crust, depending on difference of structure and composition. In none of the conglomerates or puddingstones do we observe any traces of this structure; and as it is common to the most crystalline greenstone, porphyritic greenstone, and those rocks usually denominated syenitic, there can be little doubt that it is owing to the development of a peculiar concretionary structure by decomposition.

In a small ravine, near the village of Saulminda, 2000 feet above the sea, I saw basalt of a perfectly columnar structure, and vertical, closely connected with a columnar mass, formed of concentric lamellæ, enclosing a heavy and hard nucleus. Perhaps these last were the ends of columns lying in a horizontal position.

Near this ravine I had also an opportunity of observing the gradual and perfect passage of the columnar basalt into that which has been called Stratified, from the parallelism

of its planes, the composition being identical, and, without doubt, contemporaneous. These changes and passages of one rock into the other, are so frequent and various, as to render it difficult to refer the most of them to either of the rocks I have above mentioned as types. I shall therefore proceed to describe those which are distinctly marked, and their accompanying minerals. In external appearance, the columnar and semi-columnar basalt closely resembles that of the Giant's Causeway, possessing the same fracture, internal dark colour, and external brown crust. It is equally compact and sonorous. It, however, contains more frequently crystals of olivine, of basaltic hornblende, and of carbonate of lime. The fusibility of each is the same. Perhaps the basalt of the Gawilghur Range more nearly resembles in every respect that of the Pouce Mountain in the Mauritius. This is, however, of very little importance, since every body who has travelled much in trap countries, knows well what great changes in composition and structure occur even in continuous masses. Among the minerals, calcedony and the different species of zeolite, are rarely found in the columnar basalt, but they are of frequent occurrence in that which is semicolumnar.

The wacke or indurated clay is as various in character and composition as the basalt, and, unfortunately, I have no type with which to compare it, as in the case of the basalt of the Giant's Causeway. Its colour varies with its constituents, but is most usually grey. It is easily frangible, very frequently friable, and is almost always porous and amygdaloidal. It appears to be composed of earthy felspar and hornblende, with a considerable proportion of oxide of iron. It is always easily fusible into a black scoria or glass, according with the quantity of zeolite which it contains. Of all the trap rocks it abounds the most in simple minerals.

They are Quartz and Amethyst-quartz.
Calcedony, and Calcedonic Agates, inclosing crystals of carbonate of lime.
Cachalong.
Common Opal and Semi-Opal.
Heliotrope.
Plasma, or transparent Heliotrope.
Stilbite.
Analcime.
Natrolite.
Ichthyophthalmite.
Felspar.
Carbonate of lime and Green-earth.

I have never been able to discover in it either augite or hornblende in distinct crystals. When the surface of the land is strewed with these minerals, it is a certain indication that the rock beneath is wacke. With regard to the situation of this rock, I think I have rarely seen it on the summits of hills, but much more frequently at their bases, and forming flat elevated plains. I shall have occasion to advert to this rock again when I proceed to describe the fossil shells.

The nodular basalt is perhaps the most common form of trap in this mountain-range, as well as in other parts of India. It more commonly forms the surface than either of the other rocks, and is as frequently seen on the summits as it is at the bases of the mountains. It rarely abounds in minerals of any kind. It is the principal source of the rich black diluvial soil, commonly called "Black cotton soil" of India. I have little to add to the former description of it Its internal structure is sometimes beautifully developed by decomposition, since, in a mass of about six inches diameter it is possible to count above twelve concentric layers,

and, on striking the nucleus a slight blow with a hammer, one or two more layers are broken off. It is owing to this facility of decomposition that the annual rains carry down such vast quantities of alluvial soil from its surface, which is, moreover, always strewed with an abundance of nuclei, in various stages of decomposition. It is owing to the difficulty with which the roots of trees penetrate this rock, that they are so rare on its surface, and never grow to any size. Yet this circumstance does not prevent the *Andropogon contortum* and *nardus* from growing in the most luxuriant manner, which sufficiently proves the fertility of the soil.

On ascending from the Taptee (in April 1823), I observed in a *nullah* a group of basaltic columns, one of which was two feet in diameter, and six-sided. When near the summit of the flat table-land of Jillar, I entered a pass, formed on one side by a perpendicular section of the rock from 25 to 30 feet, and on the other by a rapid descent of 40 or 50. The lower part of the section, as well as the pathway, is composed of the wacke or indurated clay of the kind before mentioned, of about 10 feet in thickness. Lying on it is a stratum of earthy clay, of different degrees of induration and purity, 20 yards in length, and about 2 feet in thickness, containing great numbers of entire and broken shells. This possesses all the characters of a stratum, since the horizontal fissures are parallel, and are prolonged, with a few interruptions, through the whole extent. The accompanying sketch (Plate VIII. bottom) will serve to give a tolerably correct idea of the mode in which the stratum appears to overlie the lower rock, and to have been depressed by that which is superincumbent. The upper rock consists of about 15 feet in thickness of the nodular basalt or wacke, the nuclei being of all sizes. The vertical fissures which are so remarkable in trap-rocks, are prolonged from both the upper and lower rocks into the shelly stratum, although

there is no intermixture of substance. The stratum is composed of a highly indurated clay, fusible before the blowpipe, into a fine black glass; and neither it, nor the shells it contains, effervesce in acids. The shells are for the most part flattened, and belong either to the genus Conus or Voluta. It is not possible to conceive that so fragile a substance as a thin land-shell should have been so completely flattened, without fracture, unless it had been previously softened by some means, which, at the same time, produced a sufficient degree of pressure to effect its flattening.

I have attempted in the sketches of the shells (Plate VIII. fig. 3, 6, 7,) to give a representation of the degree of flattening, but I fear that it can only be well understood by examining the specimens themselves. Neither the rock nor its shells effervesce in acids. Westward, the ground is covered by the debris of a shelly conglomerate, much more indurated and impregnated with green-earth*. Some of the shells are entire, but these are rarely flattened. The matrix appears to be siliceous, and in some cases approaches to imperfect heliotrope. It is not fusible before the blowpipe. I may here mention, that, in a report to the Marquis of Hastings, in June 1819, I mentioned the existence of shells in trap-rocks at Medcondah, at a height of 2000 feet above the sea. The hill was composed of nodular trap; and lying on its surface were numerous pieces of siliceous stone, containing shells of the genera Turbo and Cyclostoma. The specific gravity of the stone varied from 2 to 2.5. The shells did not effervesce in acids, although some of them preserve their external polish. Internally, some of the stones appeared to pass into flint, particularly those of small specific gravity, whilst their external surface effervesced in

* Exhibiting cavities and shells in relief. From the shape of the former, there can be no doubt of their having once contained shells

acids. Some of the small shells are completely changed into calcedony. Specimens of these shells are lodged with the Asiatic Society.

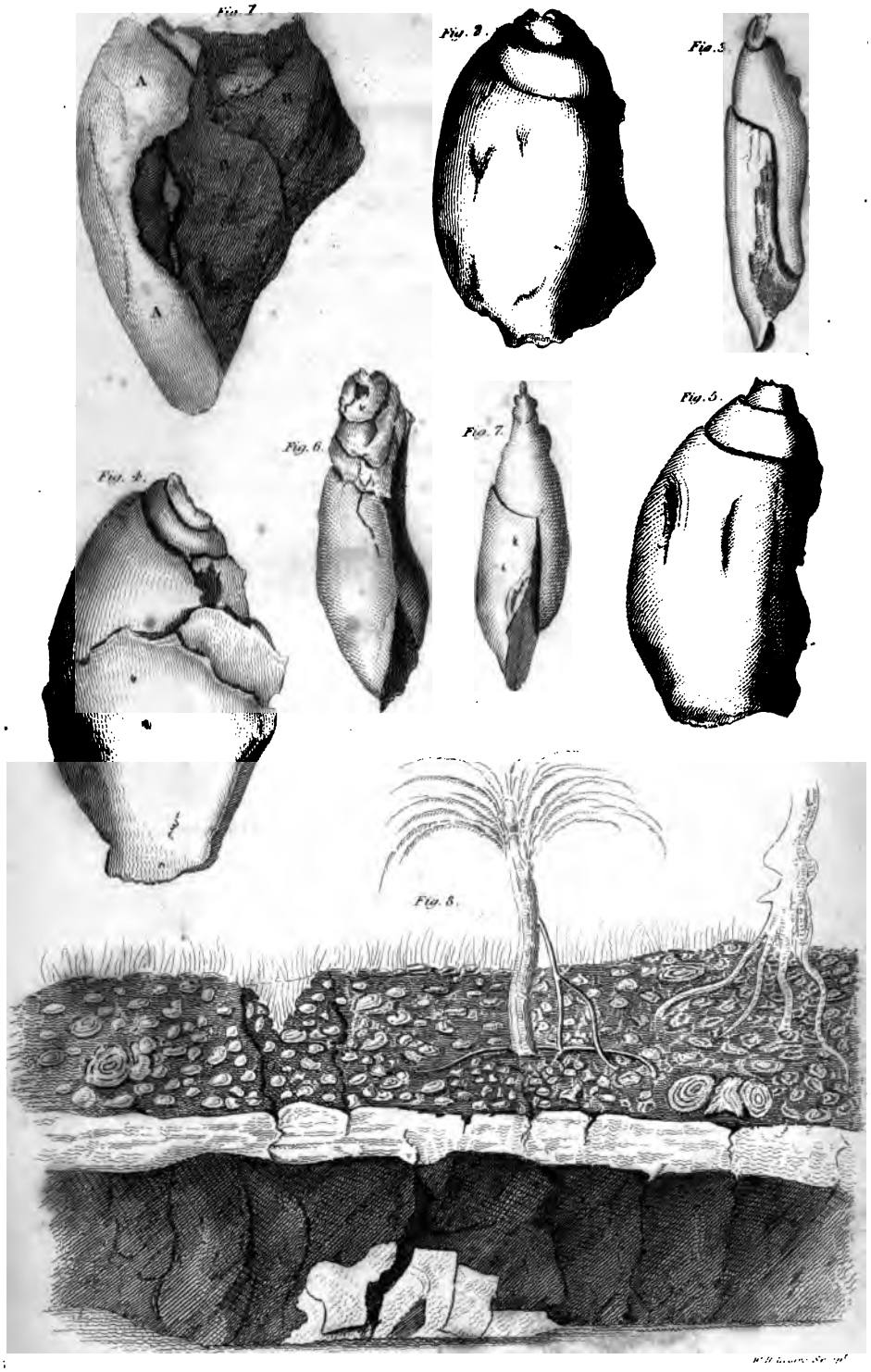
It is a remarkable fact, that the only remains of animals hitherto discovered in India, should be found in trap-rocks, and under such peculiar circumstances. 1*mo*, They are found in situations where there are no indications of the former existence of lakes; 2*do*, Both the shells and matrix are destitute of carbonic acid; 3*tio*, The former are in many instances squeezed flat, without fracture, and in some cases commixed with their matrix.

These effects could only have been produced by the agency of heat, and consequently the modern theory of submarine or subaqueous volcanoes will best serve to explain the phenomena. These shells were deposited in the stratum of clay in which they are now found, and when forced up by the mass of wacke beneath, they were most probably at the same time covered by the nodular basalt. Thus we have heat to drive off the carbonic acid, and soften these shells, under a pressure which assisted the process, and at the same time flattened them.

I have numerous collateral proofs of the intrusion of the trap-rocks, in this district, amongst the gneiss, which do not allow me to doubt of their volcanic origin. I shall take an early opportunity of completing the history of the trap-rocks of India, for which I have been collecting materials for several years past.

HYDERABAD,
July 24. 1823.

Wern. Mem. Vol. V. page 295



Explanation of Plate VIII.

Fig. 1. View of a shell much contorted by pressure, adhering to the matrix.
A A the shell.
B B the matrix.
2. Petrified shell.
3. Side-view of shell Fig. 2.
4. 5. Other petrified shells.
6. Side-view of Fig. 4.
7. Side-view of Fig. 5.

The sketch at the bottom of the plate represents the relative position of the beds of wacke, and clay containing the shells, and of overlying nodular trap.

A A Stratum of clay containing the fossil shells.
B B Bed of nodular trap.
C C Bed of wacke.
D D Trees of *Ficus Indica*.
E Surface of trap, covered with *Andropogon contortum* and *nardus*.

XVII. — *On the Geological Structure of the Hill of Seetabuldee, Nagpoor, and its immediate Vicinity.*

By H. W. Vaysey, Esq.
Surgeon to the Trigonometrical Survey, East Indies.

(Communicated by Sir James Macgregor, President of Army Medical Board.)

(*Read 6th March* 1824.)

THE Hill of Seetabuldee, although agreeing in form and interior structure with other basaltic hills in its neighbourhood, merits a more particular description, on account of some peculiarities in the composition of the main rock, hitherto unnoticed by geologists, and for the opportunities afforded by its extensive quarries of studying the varied structure of the rocks of the Trap family, which is rarely to be seen in so distinct a manner.

The mass of the hill is composed of porous basalt, with a semi-columnar appearance, derived from numerous vertical fissures. It passes, at some places in a gradual, and at others in an abrupt manner, into a coarse porous wacke or indurated clay, which in its turn changes, in a similar manner, to the nodular basalt or wacke, of which the northern and southern summits of the hill are composed.

At the junction of these rocks, the passage is sometimes so gradual, as to give the intermediate rock an indeterminate character, partaking of the nature of both. At others, it is abrupt; yet, notwithstanding the abruptness of the change, the vertical and horizontal fissures are prolonged into each other, and cross the line of junction. I shall not here enter into a more minute detail of these appearances, but shall content myself with observing, that the most satisfactory explanation of these phenomena is derived from that theory which ascribes to the trap-rocks an igneous origin, under pressure of a great body of water.

The semi-columnar basalt, forming the greater part of the hill, is very porous, containing numerous amygdaloidal cavities, which are for the most part merely lined with a peculiar mineral, which I presume to name Conchoidal Augite. Sometimes, however, they are nearly filled with it, or with calcedony, semi-opal, or carbonate of lime; the calcedony being usually covered with a coating of green earth. The rock itself is composed of hornblende and felspar, with the augite so profusely disseminated, that it ought to be considered, in some cases, as a constituent of the rock. The rock is fusible, and is of considerable specific gravity, notwithstanding its porosity. The vertical and horizontal fissures are not always straight, but are at times waved; they are also sometimes lined with an infiltration of calcedony coated with clay and chlorite.

This rock is succeeded by an indurated clay or wacke, which, at its junction with the basalt, frequently partakes of its semi-columnar structure, the vertical fissures being prolonged into the wacke, and the schistose structure of the latter extending into the basalt. These changes may be very favourably seen in the fosse which surrounds the fortification.

The indurated clay or wacke seems to form but a small proportion of the hill, as it is not seen in the hollow between the greater and lesser elevation, the semi-columnar basalt being there uncovered by any rock. It also contains crystallised carbonate of lime and semi-opal, but calcedony coated with green earth is the most common mineral found in it.

This rock passes into the nodular wacke, which, on a casual inspection, appears to be a collection of stones rounded by attrition, and involved in a matrix of clay; when examined more carefully, it is evident that this appearance is owing to a peculiar modification of the concretionary structure, developed by decomposition. Nuclei, of various sizes, are enveloped by concentric lamellæ, which peel off, as decomposition destroys their cohesion. They are consequently seen in various states of decay, and of sizes varying from several feet in diameter to several inches. But their true nature is easily discovered by the mutual indentation of the different lamellæ which surround their respective nuclei, the centres from which this pseudo-crystallisation has proceeded. The existence of the vertical and waved fissures need scarcely be adduced as farther proof that they are not the product of alluvial detritus.

It appears most probable that they owe their forms to molecular magnetic attraction, since they contain a very large proportion of oxide of iron (nearly 25 per cent.), as may be perceived by the great specific gravity of hand specimens.

The nodular wacke or basalt is one of the most common forms of trap in the extensive districts composed of the rocks of this family south of the Nerbuddah.

It occurs perpetually in the extensive and lofty range of mountains situate between the Poorna and Taptee rivers, and appears to form their principal mass. It is found

equally abundant throughout the whole of Berar, part of the provinces of Hyderabad, Beeder, and Sholapoor, and appears to form the basis of the great western range of trap-hills which separate the Konkan from the interior of the Deckan.

It is probably one of the main sources, when decomposed, of the black diluvial soil, to which Hindostan owes so much of its fertility. The valley or extended plain of Berar, that of Hoshungabad, of Seronge, of Irundiala south of the Kistnah, of the Palnad bordering the Kistnah, and numerous others, all lie near the course of rivers, which at some former period have covered these plains, and formed their extensive deposites of alluvium. Whether the deposition originated in some sudden and partial inundation, or whether it was owing to the gradual subsidence of the waters of the great deluge, I think may be determined by cautious investigation. I am at present inclined to think that the most probable cause was the latter.

The hill of Seetabuldee offers favourable opportunities, if the quarries are extended, of ascertaining positively, whether the basalt is merely a superficial deposite, or is deeply connected with a mass beneath. It is surrounded on all sides by gneiss or slaty granite, which is found at the base of the hill a few feet deep. Perhaps Nagpoor affords more opportunities than any other part of India, of studying the geological history of these rocks, as it is situate near the junction of the primary and overlying rocks. Numerous opportunities must arise during the excavation of wells and baths, of ascertaining the connection of the strata beneath. A well, in Mr A. Gordon's garden, near the base of the hill, of about 40 feet depth, penetrates through three or four feet of black soil, succeeded by a magnesian siliceous clay, which appears to owe its origin

to decomposition of the gneiss, by which it is immediately followed, and which continues to the bottom of the well.

From the summit of the hill of Seetabuldee, the difference in the outline of the rocks eastward is very perceptible.

The flattened summits, and long flat outline, with the numerous gaps of the trap-hills, are exchanged for the ridgy, peaked, sharp, outline of the primary rocks*. At Ramteak and its vicinity, the rocks are of granite and gneiss. At Doonguree, at Pullorah and Parsoonee, are found crystallised marbles passing into gneiss, capable of receiving a fine polish. "Foliated black manganese ore," in large quantity, is found here (JAMESON's Mineralogy, third edition): some of the marbles contain a small quantity of magnesia. At Khoraree, a dolomite, or magnesian marble, is found, also in gneiss. At Nyakoond Pasonee, bed of the Pesh, granite and gneiss of various kinds, quartz-rock, and sandstone, occur.

P.S. I have lately had an opportunity of fusing a large piece of the Seetabuldee basalt in a steel-furnace. The product, after an hour's fusion, was a fine black opake stone, resembling porous obsidian. Glass-bottles are commonly made in the Mediterranean from basalt, and that of Seetabuldee seems to be of an equally favourable nature for that purpose.

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* Captain Bayley's plates of the battle of Seetabuldee give a very correct idea of the first outline of the basaltic trap-hills at Nagpoor.

NAGPOOR,
May 31. 1823.

XVIII.—*Description of* Plumularia bullata, *a new Species, collected by the Arctic Expedition under* Capt. PARRY, *in Hudson's Strait*, 1821.

By the Rev. JOHN FLEMING, D.D. F.R.S.E. M.W.S. &c.

(*Read 20th March* 1824.)

THIS coralline * is irregularly branched. Each branch arises from a cell (or denticle), which has enlarged into an ovate vesicle, slightly wrinkled across. From the top of this vesicle a tubular stem proceeds, thinly covered on one side with a row of cells, some of which are enlarged into vesicles supporting other branches. The base of the vesicle is united with the mouth of the cell, but the line of separation is distinct, in consequence of the cell (and branch with which it is connected) being of a denser substance. In the younger branches, the communication between the central tube of the stem and the cavity of the vesicle is free; in the older portions, however, this connection ceases. At the external base of the vesicle, from one to three tubular radicles take their rise, and descend along the supporting stem, and others which are inferior to it, closely adhes-

* See Plate IX.

ing to the surface. These tubes are, like the stems and branches, destitute of joints. Each cell is short, scarcely the diameter of the stem which supports it, with a horizontal or slightly oblique mouth, and destitute of lateral or inferior processes. In all the cells I observed portions of a thin membrane connected or continuous with the margin, and more or less cup-shaped, which appeared to be the remains of vesicles, similar to those which give rise to the branches. Their nature was likewise pointed out by the remains of the tubular radicles still in connection with some of the largest portions. To some of the cells cylindrical bodies were attached, which, after maceration, appeared of the consistence of the body of the polypi of several Sertulariæ; but, instead of terminating in a tentacular head, became contracted, and gave rise to branches, bearing cells. In some cases, two contiguous cells supported each a vesicle bearing a branch.

The preceding description will suffice to shew, that this coralline differs from all those described by Ellis, among his Vesiculated Corallines; by Lamarck, in his genus Plumularia; or by Lamouroux, in his genus Aglaophenia. But the mutilated condition of the specimen leaves much to be desired in the characters of the species. I have observed in other vesiculated corallines* a capability, when placed in circumstances unfavourable for ordinary growth, of converting the polypi in the cells, into branches bearing cells. The anomalous appearances of this species seem to indicate that it had recently been placed in a condition where the exertion of similar energies was requisite in converting both polypi and ovaria into branches, thereby exhibiting a curious example of viviparous reproduction or extension.

* See Edin. Phil. Jour. vol. ii. p. 86.

The marine plants which were collected during the last Arctic Expedition under Captain PARRY, were consigned to the care of Dr HOOKER, for examination. There were a few zoophytes among them, which that distinguished botanist requested me to name. Though they were all found on the surface of the sea, about the middle of Hudson's Strait, 29th July 1821, they were, with few exceptions, such as ELLIS has described, as inhabitants of our own shores, differing, however, somewhat in habit. Among the Sertulariadæ, one occurred which, from the preceding description, seems to be new, and the structure of which serves to throw considerable light on the physiology of the tribe. The drawing, which is now transmitted, will serve to exhibit the different stages of its growth. (Plate IX.)

Judging from the structure of the whole specimen, there seems to be ground for entertaining the belief, that each branch, in ordinary circumstances, takes its rise from an organ, which in many other species serves the purpose of an ovarium, and was termed by ELLIS a Vesicle. In this manner we can conceive each colony, the individuals of which are connected together either mechanically or organically, increasing to an indefinite size, and the common base acquiring proportional strength by the tubular radicles each new branch protrudes. But in what manner are new colonies formed? The specimen examined throws no light on this part of the history of the species; but analogy leads to the conclusion, that some of the vesicles may, at times, perform their function of ovoviviparous reproduction. The appearances exhibited by this coralline lead us to infer, that those "little regular arch-like risings," which ELLIS observed on his specimen of Sertularia *myriophyllum*, and which is common to the species, may be vesicles supporting branches similar to our species.

In the Plumularia *bullata* the bodies of the polypi them-

selves appear in progress towards the formation of branches. This curious circumstance may be accounted for, by taking into consideration the condition in which the specimen was found,—detached, and floating along with sea-weeds. It may have been brought from a considerable distance, and, in its new station, have suffered from several external agents. Hence it appears to have acted in a manner similar to what we have witnessed in the Sertularia *gelatinosa* of PALLAS,—by absorbing the tentacula of its polypi, and enlarging their bodies into branches.

These observations have been brought together, as serving to illustrate the organisation of the zoophytes, a subject which has been but imperfectly considered. The exterior covering of these animals is frequently, but erroneously, viewed as similar to the extravascular dwellings of the bee, or the subextravascular shells of the Mollusca; while, in its mode of growth, it is analogous to bone, a circumstance on which its *apparent* vegetating power depends.

Plate IX. Fig 1. Natural size.
2. A portion magnified.

MANSE OF FLISK,
March 12. 1824.

PLATE IX *Engd for the Wern. Memoirs Vol. V p. 3*

Fig. 1.

Fig. 2.

W H Lizars

XX.—*Commentary on the Herbarium Amboinense.*

By Francis Hamilton, M. D.,

Fellow of the Royal Societies, and Societies of Antiquaries of London and Edinburgh; of the Linnæan Society of London; and of the Asiatic Society of Calcutta.

(*Read* 14*th June* 1823, &c.)

LIBER PRIMUS.

Caput I. II. III. & IV.

Palma indica major, p. 1, t. 1, 2, 3.

This is the best account that I have seen of what modern botanists call the *Cocos nucifera*. In the second chapter are enumerated thirteen species, which seem to be of the nature which botanists call Varieties, as arising in the kinds of plants that are much cultivated. The only one that may perhaps be a distinct species, seems to be the 12th, or Terri, (p. 12.); concerning which, however, I know nothing farther than what Rumphius states.

Caput V. & VI.

Pinanga domestica, p. 26.

This is the *Areca Catechu* of modern botanists, concerning which I may refer to my Commentary on the first part

of the "Hortus Malabaricus;" and I must remark, that Rumphius is as free as Rheede from the error of supposing that Catechu (*kath*) is made from this palm; and from this error the authors of the Encyclopedie (i. 240) are also exempt. Rumphius mentions four principal varieties, and several others of less note; but none of these seem to be what botanists call distinct species.

Caput VII.

Pinangæ sylvestres, p. 39.

The authors of the Encyclopedie first introduced these into the system of modern botany, and were followed by Willdenow; but I suspect that both followed Rumphius entirely, without having seen the plants; and that Willdenow, in forming the specific characters from the stipites, has not always understood the meaning of his author. I shall now enter into particulars, the different kinds enumerated by Rumphius being not mere varieties of cultivated plants, but distinct species.

Pinanga sylvestris globosa, p. 38, t. 5, f. 1, A.

This the authors of the Encyclopedie (i. 241) call Areca *spicata*, a name adopted also by Willdenow (Sp. Pl. iv, 595); but Gærtner (De Semin. i. 24, t. 9, f. 3) considers it as of a different genus, and calls it Euterpe *globosa*. I doubt much of the propriety of founding new genera of Palms merely from differences in the situation of the embryo, and suspect that the practice will lead to an arrangement altogether unnatural. Few palms are more different than the Coryphas and Pinangæ *sylvestres*, that have been united to form the genus Euterpe (Enc. Meth. Sup. ii. 623).

Pinanga sylvestris glandiformis prima, p. 38, t. 6.

In the Encyclopedie (i. 241), and by Willdenow (Sp. Pl. iv. 595), this is called Areca *glandiformis*.

Pinanga sylvestris glandiformis secunda, p. 39.

I think that in the Andaman Islands I have found this palm, the nuts of which were used, instead of the betel-nut, by the convicts confined on the island. I call it

Areca laxa foliolis binerviis, caudice incurvo, floribus triandris.

The following account I have extracted from notes taken on the spot.

Caudex sæpius incurvus, nunquam ut in Catechu strictus, pedes 20—30 altus, annulatus, inermis, apicem versus politus, viridis, tumidus.

Frondes cum impari pinnatæ. Pinnæ lanceolatæ, acutæ, integerrimæ, plicis quatuor binerviæ, e medio stipitis laterum superiorum enatæ, æquidistantes. Stipes inermis. Rachis triangularis, latere inferiore convexo.

Spatha nuda, monophylla, ex apice trunci annulati infra partem tumentem enata, lanceolata, acuta, extra convexa, intra concava, marginata, integerrima, decidua, interius dehiscens. Spadix decompositus, interne planus, nudus; externe convexus, ramosus. Rami angulati, ramosi. Ramuli hinc læves, inde denticulati.

Masculini flores plurimi, minuti, sessiles, bini singulis ramulorum denticulis insidentes. Calyx triphyllus, rigidus, foliolis lanceolatis, acutis, conniventibus. Filamenta vix ulla. Antheræ tres oblongæ. Pistilli rudimentum nullum.

Fœmininæ flores paucæ, solitariæ, ad basin ramulorum ramis adnatæ, masculinis centies majores. Calyx triphyllus, convolutus foliolis ovatis, concavis. Petala tria viridia, ovata, acuminata, circa germen arcte convoluta, calyce longiora, ovata, concava. Germen obsolete trigonum, ovatum, acuminatum. Stylus nullus. Stigma acutum.

Pericarpium non vidi.

In the woods of Chatigang and Rangpur I found another Palm very nearly allied to this of Rumphius, and

which, in the former, was called Ram Gua, or Wild Betel-nut, while, in the latter, it was called Runi Supari. I sent plants to Dr Roxburgh, thinking it might be the *Areca alba;* but Dr Roxburgh was of a different opinion, and called it *Areca triandra*, a name not very appropriate, as applicable to several species.

Areca triandra pinnis lateralibus falcatis, acutis; terminali bifurca, præmorsa.

Areca triandra, Hort. Beng. 68.
Areca alba, Willd. Sp. Pl. iv. 596? Encyc. Meth. Sup. v. 441?
Ram Gua, Runi supari } Bengalensium.

Habitat in sylvis Camrupæ et Tripuræ.

Caudex strictus, 12–20 pedes altus, annulatus, inermis; apice lævi, viridi, tumente. Stipites læves, longitudine fere frondis subteretes, basi dilatato amplexicaules. Rachis communis subanceps, supra carinata.

Frondes cum impari pinnatæ. Pinnæ sessiles, longitudinaliter decurrentes, integerrimæ, nudæ, ad nervos 6—12 plicatæ; laterales falcatæ, acutæ; terminalis bifurca lobis divergentibus, præmorsis.

Spatha ex apice caudicis annulati infra partem tumentem enata. Spadix ramosissimus, erectus.

Flores omnino ut in A. laxa, sed antheræ sagittatæ; stigma trilobum.

Bacca magnitudine amygdali oblonga, utrinque acumine obtuso terminata, glabra, pulpa molli rubra tenui tecta. Semen bacca conforme, integumento crasso lignoso fibroso tectum. Albumen absque cavitate ruminatum. Embryo in basi seminis positus, conicus.

Very nearly allied to this last is a small Palm, which I found near Goyalpara, and which is probably the *Areca gracilis* of the Hortus Bengalensis (68), as Dr Roxburgh received his plant from the neighbouring territory (Sylhet), and as the name is very applicable; but I did not observe the plant in the garden at Calcutta. I should have considered it as the same with the next plant described by Rumphius, on account of its *truncus gracilissimus et te-*

nuissimus (p. 41, § 2.); but its fruit is too large. I shall here content myself by giving a few notices concerning this palm.

Caudices aggregati, pollice vix crassiores, pedes 8 vel 9 longi.
Frondes omnino ut in A. triandra.
Flores non vidi.
Spicæ fructiferæ simplices, recurvatæ, angulatæ, undique aspersæ baccis calyci marcescenti insidentibus.
Bacca ovata utrinque acumine obtuso terminata, parva, glabra. Caro fibrosa, tenuis, undique semini adhærens. Semen ovale, fundo baccæ absque funiculo umbilicali adhærens. Albumen ruminatum, nulla cavitate in medio insculptum. Embryo conicus, albidus, in basi seminis nidulans.

Pinanga sylvestris oryzæformis, p. 40, tab. 5, fig. 2, et lit. B. C. & D.

The authors of the Encyclopedie (i. 241), and after them Willdenow (Sp. Pl. iv. 596), call this *Areca globulifera;* while Gærtner (De Sem. i. 19, t. 7, f. 2.) calls it *A. oryzæformis*, which seems the preferable name, being that first given.

Pinanga sylvestris Saleyt dicta, p. 41.

In modern systems this remains entirely unplaced.

Pinanga sylvestris saxatilis, p. 42, t. 7.

Willdenow calls this the *Areca humilis* (Sp. Pl. iv. 595.) Loureiro imagined that he had seen the plant in Cochinchina, and called it *Borassus caudata*, in which he is followed by the Encyclopedie (vi. 258); but then there is great reason to suspect that the plant which Loureira saw is quite different from that of Rumphius, as the author of the Encyclopedie, copying from Loureiro, describes an undivided spadix, and three nuts in each fruit, while Rumphius represents the spadix as branched, and the fruit as resembling that of the *Pinanga oryzæformis*, which has

only one seed. The compiler of the Supplement to the Encyclopedie (i. 140), with his usual candour and judgment, has abandoned this plant of Loureiro, at least as being the same with the *Pinanga sylvestris saxatilis*, and adopts the name *Areca humilis* of Willdenow.

Caput VIII.

Saribus, p. 42, t. 8.

This is the *Corypha rotundifolia* of the Encyclopedie (ii. 131), and of Willdenow (Sp. Pl. ii. 201); but its belonging to the genus *Corypha* is extremely doubtful, and rests entirely on the comparison which Rumphius draws between it and the Codda Pana of the Hortus Malabricus, —"quæ quoad folia magnam cum Saribo nostra habet convenientiam—verum tantum differt, ut diversa sit habenda species," (44). The Saribus is therefore as likely to be a Chamærops or Rhapis, and still more likely to be a Licualia than a Corypha. I cannot, indeed, help wondering, that Gærtner (De Sem. i. 18) should have confounded it as a species with the Codda pana of the Hortus Malabaricus. This renders what he says concerning the fruit of the Corypha quite uncertain, as no one can tell whether he described the fruit of the Codda pana, or that of the Saribus; yet I suspect that most of the recent generic characters given of the Corypha are derived from this uncertain source.

Limalia arbor, p. 44, t. 9.

The authors of the Encyclopedie (ii. 201) called this at first the Corypha *licualia*, and it has perhaps as good a claim to remain in that genus as the Saribus; but Thunberg has made it a distinct genus; and it is now the Licualia *spinosa* of Willdenow (Sp. Pl. ii. 201), a name

adopted in the Supplement of the Encyclopedie (iii. 450), and by most recent botanists.

When in Chatigang, I observed a species very nearly allied to this, and sent specimens, and a description, to Sir Joseph Banks; and, on the 24th April 1798, I sent seeds to Dr Roxburgh. I have since found the same plant on the hills of the Rangpur district; and Dr Roxburgh procured it from his son, for the Botanical Garden of Calcutta, where it is called Licualia *peltata*. I annex a description taken from my Notes.

Licualia peltata stipite aculeato, frondi flabelliformi, staminibus distinctis.

Kurup et Kurkuti Bengalensium.
Habitat in montibus ultra Gangem.

Caudex 3—5 pedes altus, crassitie brachii humani curvus, teres, lævis, apicem versus stipitum rudimentis exasperatus, plerumque simplicissimus, sed aliquando vidi ramos paucos ut in Cycis.

Frondes 5 seu 6 confertissimæ, sparsæ, horizontales, peltatæ, subrotundæ, 8—12 partitæ laciniis cuneiformibus, ad latera integerrimis, apice præmorsis, nitidis, glabris, ad nervos longitudinaliter plicatis, pedem unum vel alterum longis. Stipes trigonus, longus, patens, imberbis, utrinque aculeis rectis horizontalibus validis armatus. Stipulæ retiformes, laceræ, basin stipitis investiunt.

Spadix erectus, foliis longior, interruptus articulis ad basin compressis lævibus, apicem versus incrassatis tomentosis. Spicæ simplices, teretes, ex apice singulorum articulorum solitariæ, secundæ, resupinatæ, pedem longæ, multifloræ. Pedunculus communis compressus, angulatus, tomentosus. Flores plurimi, sparsi, magnitudine florum hyacinthi. Spathæ vaginantes, læves, teretes, laxæ, basin articulorum spadicis singulorum tegentes, ore oblique-truncato, indefinite dentato.

Calyx monophyllus, subcylindricus, inferus, ore tridentato. Corolla monopetala, calyce duplo longior, persistens, trifida laciniis ovatis acutis patulis. Filamenta sex, ovata, acuta, plana, distincta. Antheræ sagittatæ, erectæ, corolla breviores. Germen oblongum, truncatum. Stylus subulatus, staminibus longior. Stigma simplex.

Bacca aurantii colore oblonga, basi attenuata, stigmate coronata, unilocularis. Cuticula punctata. Caro succulenta, fibrosa,

undique semini adhærens. Semen unicum, grande, forma baccæ leve. Integumentum duplex; exterius crustaceum, durum, tenue; interius membranaceum, utrumque arctissime adnatum. Albumen semini conforme, cartilagineum, cavitate obliqua, utrinque attenuata, apicem prope et basin seminis hinc inde attingente perforatum. Embryo ovalis, semini prope basin (cavitatis extremitati inferiori oppositus) immersus, utrinque obtusus, lacteus.

Caput IX.

Lontarus domestica, p. 45, t. 10.

Jussieu (Gen. Pl. 45) proposes to restore the name Lontarus, in place of Borassus, the name given by Linnæus, and since adopted by most botanists, but derived from the name of a part (spatha) common to most palms. The name *domestica* is well chosen, as I have never seen the palm except near villages; while *flabelliformis*, the specific name usually given since the time of Linnæus, is applicable to every species which can be considered nearly related to the same genus. I consider, therefore, that Gærtner was perfectly justifiable in having (De Sem. i. 21) restored to this palm the name Lontarus *domestica*. Indeed, it may be observed, that Linnæus very commonly changed the names given by Rumphius for the worse, and that the plan of making the generic name a substantive, agreeing with an adjective for a specific appellation, seems to have been borrowed from the venerable Dutch Governor, although Linnæus has generally received credit for the invention. No doubt, however, Linnæus followed the rule almost universally, while Rumphius only adopted it in a great proportion of instances.

Caput X.

Lontarus sylvestris, p. 53, t. 11.

In the Encyclopedie (ii. 131) this is considered as a species of Corypha, and has the barbarous specific name *utan*.

Dr Roxburgh (Hort. Beng. 25) adopted the same names, and is an excellent authority for placing it in the same genus with the Corypha described by Rheede, having examined the fructification of both palms.

Lontarus sylvestris Yhur dicta, p. 54.

This is evidently a palm, with leaves shaped like a fan, and which produces a sago; but to what genus it belongs, no one can say, from any thing that Rumphius states.

Lontarus sylvestris Cabang, p. 55.

This is a palm very nearly allied to the Licualia *peltata*, already described, but distinguishable by the smaller number of sections into which its leaves are divided. It serves, however, similar purposes, and probably belongs to the same genus.

Caput XI.

Lontarus sylvestris altera, p. 56, t. 12.

From the fruit containing three or four nuts, and from the general appearance of the plant, I consider it probable that this palm is a species of Borassus or Lontarus.

Caput XII. & XIII.

Palma indica vinaria secunda, p. 57, t. 13.

Burman, in his Commentary, considered this is a Chamærops; and the authors of the Encyclopedie (vi. 258), misled by Loureiro, looked upon it as a Borassus, which obtained the specific name *gomutus*. Both Chamærops and Borassus having fan-shaped leaves, while those of the palm in question are pinnated, these arrangements were quite unnatural, no circumstance in this natural order producing such a change of appearance as the form of leaf. Dr Roxburgh, accordingly, (Hort. Beng. 68), with great

propriety, considered this as not belonging to any Linnæan genus, and, adopting one of the names used by Rumphius, called it Saguerus Rumphii; which I think preferable to the name Arenga given to it by Labillardiere (Enc. Meth. Supp. i. 441), and probably derived from Aren of the Japanese.

Arbor Tsiang, p. 63.

This palm, Rumphius says, has an appearance intermediate between the Saguerus and Saribus, one having pinnated, and the other fan-shaped leaves. On this account, it may be perhaps considered as nearly allied to the Levistonia of Brown (Nov. Holl. i. 267).

Caput XIV.

Seguaster major, p. 64, t. 14.

This is usually quoted by botanists for the Caryota *urens*; but, in my Commentary on the First Part of the Hortus Malabaricus, I have expressed a doubt whether this be the same with the Schunda *pana*, and to that Commentary I must here refer.

Caput XV.

Seguaster minor, p. 67, t. 15.

I do not find that any modern botanist quotes this palm; and Burman in his Commentary seems quite wrong in considering it as a Caryota, as it has simply pinnated leaves. It is more probably an Areca, and seems in particular very nearly allied to the Areca *humilis* of Willdenow, which has been already mentioned in this Commentary. It would appear that each fruit has only one seed, otherwise, from the form of the leaves, I should have thought that it belonged to the same genus with what Dr Roxburgh (Hort. Beng. 68) called Wrightia *caryotoides*; and as the two

seeds of the Wrightia adhere closely, forming as it were one body, I am still inclined to think that this may be the case. I shall therefore give here some account of the Wrightia of Dr Roxburgh, as probably belonging to the same genus with the Seguaster *minor*. As another plant, however, has been called Wrightia by Mr Brown (Nov. Holl. i. 467), this palm should obtain another name. In the year 1798, I found it in Chatigang, but only in leaf, and sent specimens of these to Sir Joseph Banks. At the same time I sent roots to Dr Roxburgh, but it would appear that these did not succeed; and he afterwards procured plants from Mr Peirard. The name of this plant, as given to the last mentioned gentleman by the Bengalese, is Chilpata; but to me they called it Harina, a name I would propose for the genus. The fugitives from Aracan, or Rakhain, then in the district of Chatigan, called it Mu-zha Ma-tan Raik. I have since found the plant on the hills near Goyalpara.

Harina caryotoides.

Habitat in montibus Bengalæ orientalis.

Radix fibrosa. Caudex nulla. Stipites radicales, congesti, obsolete trigoni, erecti, læves, octo pedes longi, pollicem crassi, indivisi. Frondes 6—8 pedes longæ, cum impari pinnatæ. Pinnæ laterales inferiores sæpius hinc inde 2 vel 3 approximatæ; superiores solitariæ, alternæ, pedes 2 longæ, semipedem latæ, ad basin cuneatæ, integerrimæ, apicem versus truncato-lobatæ lobis apice præmorsis; terminalis flabelliformis, parva, præmorsa: omnes nervosæ, supra nitidæ, subtus albidæ. Rachis communis subtus rotundatus, supra canaliculatus. Stipulæ fibrosæ, reticulatæ stipites infra involunt.

Spadix cubitum longus, erectus, intrafoliaceus, spicas breves habet paucas, sparsas, erectas, rigidas. Rachis communis obtus angulus, squamulosus, foveis unifloris aspersus. Flores parvi, apice rubicundi; spicæ apicem versus masculini pauci, basin versus fœmininæ plurimæ.

M. Calyx crassus, subrotundus, truncatus, subtriphyllus foliolis concavis, altero marginum exteriore imbricatis. Petala tria, calyce longiora, unguibus latis subcoalita. Stamina sex, corolla breviora.

F. Calyx et corolla ut in Masculino. Stamina abortives tria, petalis alterna. Germen magnum, ovatum, superum. Stylus nullus. Stigma emarginatum.

Bacca dura, sicca, ovata, bilocularis. Semina solitaria, magtudine semen Coffeæ paulo exsuperantia, hinc plana, inde convexa, ovata. Albumen forma seminis. Embryo parvus, centripetus, in dorso seminis convexo nidulans.

Seguaster minor e qua latrones Sargilæ hastas formant, p. 68.

Whether this be a mere variety, or a different species, is uncertain; but the latter seems the most probable.

Seguaster minor forma foliorum et ramorum diversa, p. 68.

Rumphius says expressly, "una habenda est species cum seguastro minore;" yet, from the account which he gives, the difference seems very great.

Caput XVI.

Nypha, p. 69, t. 16.

This is the Nipa *fruticans* of Willdenow (iv. 597), and of the Encyclopedie (Sup. iv. 98). It is exceedingly common on the muddy banks of the Gangetic estuaries, from whence it is often washed away, and floats entire into the sea, where sailors mistake it for the Coco-nut palm.

Caput XVII. XVIII.

Sagus seu Palma farinaria, p. 72.

Rumphius first describes at great length the habit of this genus, which, after him, is now generally called Sagus, although an attempt has been made to call it Metroxylon; but this attempt has luckily proved abortive. Rumphius then proceeds to mention four kinds, which seem to be distinct species, although they all produce sago; but this, or

an analogous substance, is produced from the stem of several other palms.

Sagus genuina, p. 75, t. 17 & 18.

Dr Roxburgh (Hort. Beng. 68) called this Sagus *inermis;* but it is certainly the Sagus *Rumphii* of Willdenow (Sp. Pl. iv. 404). As it is from this that by far the greater part of sago, and that of the best quality, is prepared, I think that the name of Rumphius is by far the most appropriate. The author of the Supplement to the Encyclopedie (v. 13) doubts, whether this Sagus *genuina* be a different species from the Sagus *farinifera* of that work (vi. 394); but this doubt seems unnecessary, as the sago of the Sagus *farinifera* is the worst of all others. It is to the Sagus *genuina*, probably, that we should refer the Arbor Zagoe *Amboinensis* of Seba, which Burman (Hor. Ind. 240), and Willdenow (Sp. Pl. iv. 844), have referred to the Cycas *circinalis;* for I may venture to affirm, that sago never was procured from the stem of the Todda *pana* of the Hortus Malabaricus (iii. 9), although the nuts of this tree, when bruised, give a flour, that is used in Malabar as an aliment. This error, clearly pointed out by Rumphius (p. 92), seems to have arisen from Rheede's having mistaken his Toddo *pana*, one of the most common trees in Malabar, for the Soteetsou of Japan. It must farther be observed, that Rumphius, far from describing various kinds of the Olus *calappoides*, that produce sago, as the younger Burman asserts, describes the sago to be the produce of a totally different plant, as here mentioned; and it is to be lamented that the younger Burman did not attend to the excellent observation of his father on this subject, contained in this volume of Rumphius, p. 78.

Sagus sylvestris, p. 75.

This species has not been taken up by any author that I have seen.

Sagus longissima, p. 75.

This is the Sagus *farinifera* of Gærtner (De Sem. ii. 186), and of the Encyclopedie (vi. 394), a name not so well chosen as that of Rumphius; for sago is not a farina, and, if it were, this species produces the worst sago of any enumerated by Rumphius. On this account, it is probably not the Metroxylon *sagu* of Rottbol, who, according to the Hortus Kewensis (v. 281), meant the Sagus *genuina*.

Sagus lævis, p. 76.

This name Dr Roxburgh (Hort. Beng. 68) has changed to Sagus *spinosa*, an alteration not for the better, as all the four kinds mentioned by Rumphius are spinous. I do not find this plant taken up by any other recent author.

Caput XIX.

Sagus filaris, p. 84, t. 19.

This would seem to belong to a different genus from the four species of Sagus described by Rumphius in the two preceding chapters.

Bisula, p. 85.

A palm resembling the Lontarus *sylvestris* already mentioned, and therefore nearly allied to the Corypha, Licualia, and Borassus; but nothing is said to enable us to judge to which it is most nearly allied, except that its fruit, being compared to that of the Pinanga (Areca) or Betel-nut, probably contains only one nut, and it therefore should not be a Borassus.

Caput XX.

Olus calappoides, p. 86, t. 20, 21.

The younger Burman (Fl. Ind. 240) quotes the Olus *calappoides* (p. 86) for the Cycas *circinalis* of Linnæus, by which this great naturalist meant the Palma *farinifera Japonica*, Setitsou *Japonensibus* of Breynius (Fl. Zeyl. 393), as producing sago, although he quotes as synonymous the Palma *prunifera Japonica* of the Hortus Malabaricus (iii. 9, t. 13—21). Now, this quotation is erroneous; for, in the places referred to, Rheede describes the Todda *panna*, one of the most common productions of the coast of Malabar; and although he alleges that it also grows in Japan (p. 12), where its stem produces sago (p. 13), I have no doubt that this is an entire mistake, (see the Commentary on the Sagus *genuina*, and Buchanan's Mysore, ii. 469); for Thunberg refers the Tessio, or Sotits, of the Japanese, if that be the same with the Soteetsou, Setitsou, or Sotectsou, to the Tetsiœ of Rumphius, which will be afterwards mentioned.

But farther, the proper Olus *calappoides* of Rumphius, described in page 86, is not figured in the tables 22 and 23, as Burman would have it. The male plant is represented in tables 20 and 21, and Rumphius gives no figure of the female; but it is from the form of the female spadix chiefly, that the species of Cycas can best be determined. In the text, however (p. 87), Rumphius describes this very clearly,—" Extremum petioli, e quo fructus dependent, æmulatur planum pueri manum seu cristam galli;" from whence we may probably conclude, that the Olus *calappoides* (p. 86, t. 20, 21) is nearly related to the Cycas *revoluta*, as described by Sir J. E. Smith, in the Linnæan Transactions (vi. 312, t. 29, 30); but this, it is admitted, is the Olus *calappoides sinensis* (p. 92, t. 24), which Rum-

phius clearly distinguishes from the Olus *calappoides*, as he also (p. 90) does the Todda *pana* of Rheede. If the figure of Rumphius could be depended on, we might readily distinguish these species, as it represents the stipites of the Olus *calappoides* as unarmed; but in the description (p. 86), he says, "Rami (stipites) a trunco usque ad foliorum ortum ad margines brevibus obsiti spinibus."

On the hills which bound Bengal to the east, I have found the female of a Cycas, which may be the plant of Rumphius, and which I shall here describe.

Cycas pectinata stipitibus aculeatis; spadicibus fœmininis mucronatis, utrinque pectinatis.

Cycas angulata, Brown, Nov. Holl. i. 348.?
Olus calappoides, Herb. Amb. i. 86, t. 20 et 21.
Ban Khejur Bengalensium.
Habitat in Camrupæ orientalis sylvis.

Truncus 7—10 pedes altus, subramosus, teres, annulatus.

Frondes in trunci apices confertæ, pinnatæ. Pinnæ æquidistantes, subopositæ, decurrentes, lineares, acutæ, margine revoluto integerrimæ, avenes, uninerves junioribus tomentosis. Stipites ancipites, tomentosi, aculeis utrinque pectinati.

Flores dioici; in arbore fœminina capitulum terminale, orbiculatum, depressum, arctissime spadicibus ferrugineo-tomentosis imbricatum, undique intus gummi scatens, squamis spathaceis tomentosis pluribus brevibus cinctum. Spadix basi anceps, apice dilatatus in squamam crassam, incurvam, ovatam, mucrone rigido acuminatissimam, utrinque pectinatam. Floculi utrinque 2 vel 3 foveis totidem in basi spadicis utrinque insculptis nidulantes.

Calyx vel petala nulla. Germen compressum. Stylus nullus. Stigma acutum.

Capitulum fructiferum arcte spadicibus acutissimis imbricatum.

Drupa obliqua, obovata, magnitudine ovi compressa, basi hylo notata, nuda, rugosa. Cortex tenuis, papyraceus, arcte adhærens. Caro tenuis, fungosa, ossiculo adnata. Putamen forma fructus osseum, tenue, læve, basi acuminatum, et poro perforatum. Receptaculum nullum, semine ad apicem putaminis adhærente. Semen unicum fructu forma conforme. Integumentum intus nitidum, spadiceum, membranaceum, putamini adhærens, ab interioribus facile secedens, apicem incrassatum

intra hilum albuminis immittens. Albumen semine conforme, oblique compressum, obsolete sulcatum, carnosum, album. Embryo oblongus, utrinque acutus, verticalis, ex apice albuminis poris nonnullis pertuso ramentis umbilicalibus contortuplicatis dependens.

Obs. Quod ego *embryonem* vocavi, Brownius (Nov. Holl. i. 347) pro *vitello* embryonem includente habuit.

Differt a C. circinali spadicibus fœmininis profundius incisis, fructiferis erectis, incurvis.

Olus calappoides, e Celebe cujus fœminina Lagogo et masculina Patuka vocantur, p. 87; ut et illa ex Insulis Ulasseriensibus, p. 89, t. 22 et 23.

The account of these plants given by Rumphius is not very distinct. He seems especially to have been uncertain whether or not the Lagogo and Patuka of Celebes were different from the Olus *calappoides* figured in plates 20 and 21, and in Amboina called Nuvel and Utta Nuer. Perhaps they are really the same, although, in the explanation (p. 91), tables 22 and 23 are referred to the Lagogo and Patuka. The explanation of the plates, however, seems to have been written by Burman with little care; and it may be suspected that these two plates represent the palms which were brought to Rumphius from the Uliasser Islands. They, no doubt, represent the Todda *panna* of the Hortus Malabaricus, and are therefore justly quoted by Burman (Fl. Ind. 240), Willdenow (Sp. Pl. iv. 844), Roxburgh (Hort. Beng. 71), and the Compilers of the Encyclopedie (ii. 23), for the Cycas *circinalis;* while the description given of the female spadix of the Olus *calappoides* (tables 20 and 21) renders it certain that the latter figures represent a totally different plant, notwithstanding the assertion of Loureiro (Enc. Meth. Supp. ii. 425).

The Cycas *circinalis* is a very common plant in Malabar, and I suppose must have been mistaken for the Sagus *ra-*

phia; and a report of this circumstance must have led the Compiler of the Encyclopedie (vi. 393) to make this a native of India, especially of Malabar. But having travelled much through this latter country, as well as through India in general, if this name is confined to Hindusthan, I may venture to say, that neither produces any species of Sagus, and the Todda *panna* is the only plant of Malabar that could be mistaken for such. Willdenow seems therefore perfectly right in confining the Sagus *raphia*, which he calls Ruffia (Sp. Pl. iv. 403), to Madagascar, although it may probably be found in other parts of Africa.

Planta Osmundæ genere Pappa dicta, p. 89.

We have no figure of this plant, which is a native of Celebes; nor are we even certain of its not being actually a Fern; but it is more probably a Cycas.

Arbor calappoides sinensis, p. 92, t. 24.

All modern authors agree in calling this the Cycas *revoluta*, the female fructification of which has been most accurately described and delineated in the 6th volume of the Linnæan Transactions, by my worthy friend Sir J. E. Smith. A very great difficulty occurs in Thunberg making this the tree, the stem of which produces a most nutritious substance, so precious, that it is a capital crime to export the tree from Japan, while its fruit is an esculent drupe. The drupe probably may be used as a wretched aliment in times of scarcity, as is the case in Malabar with that of the Cycas *circinalis* (Buchanan's Mysore, ii. 469); or in times of mourning, as, according to Rumphius (p. 90), is done in Tamboca: but this intelligent and inquisitive author denies his ever having heard that a nutritious substance like sago could be procured from the stem of the Olus *ca-*

lappoides sinensis (p. 92), and he says that it is cultivated by the Chinese and Japonese as an ornament,—" ob plumosam ejus formam." Rumphius spells its Chinese name Titsjiu, which is no doubt the same with Tessio, the more learned name of the Cycas *revoluta*, which is called Sotits, and Sodots, by the vulgar in Japan. I am inclined to suspect that the resemblance, however imperfect, between these latter names and Setitsou, Sotectsou, and Soteetsou, is the only foundation for supposing that the Cycas *circinalis* produces the most valuable kind of sago; and I am inclined to think that the Setitson is not, as Rheede supposed, a Cycas, but a real Sagus.

Caput XXI.

Manga domestica, p. 93, t. 25.

This is the Mangifera *Indica* of Linnæus and subsequent authors, a name as improper, as if we were to call the apple-tree Malifera *Europæa*. The species of Manga mentioned by Rumphius are varieties, in a botanical sense; and, in fact, the varieties cultivated in India are fully as numerous as those of the apple found in Europe.

Manga Pau in Banda vocata, p. 96, t. 26.

In neither description nor figure can I discover any essential difference between this and the Manga *domestica*.

Manga sylvestris prima, p. 97.
Manga sylvestris secunda, p. 97.

Table 27 is said to represent the Manga *sylvestris*, but no notice is given to which of the species it should be referred. If we might venture to judge from the position of the leaves in the figure, this should be the Mangifera *oppositifolia* of the Hortus Bengalensis (18), of which I trans-

mitted an account from Ava, which was given to Sir Joseph Banks under the name of Mangifera *Marian*, the latter word being its name in the language of Ava.

Arbor ramis angulatis; foliis oppositis, petiolatis, lanceolatis, integerrimis, acuminatis, venosis, nitidis, nudis. Petiolus brevissimus, supra concavus, estipulaceus.

Spicæ simplicissimæ, folio multum longiores, axillares et terminales. Pedunculus tetragonus, acutangulus. Flores terminales terni; laterales oppositi, solitarii, sessiles, remoti: explanatos non vidi.

Drupa compressa, flava, pulcherrima, glabra, figura et sapore mangiferæ indicæ, ossiculo fibroso solitario monospermo.

From the inflorescence, as above described, it will appear, that, however nearly allied by the singular position of the leaves, the Marian must be different from the plants of Rumphius, which have the flowers disposed in panicles. The two kinds of this author seem distinct species, which may be thus distinguished from each other, and from the Marian. The name given to this latter by Dr Roxburgh is now improper, being equally applicable to two other species.

1. *Mangifera Mariana* foliis oppositis, floribus spicatis, pedunculo tetragono.

   Mangifera oppositifolia, Hort. Beng. 18.
   Ma-rj-an Burmanorum.
   Habitat in regno Peguensi.

2. *M. Utana* foliis oppositis, floribus paniculatis, fructu glabro.

   Mangifera sylvestris prima, Herb. Amb. i. 97, t. 27?
   Habitat in Amboina et Insulis vicinis.

3. *M. Taipa* foliis oppositis, floribus paniculatis, fructu piloso.

   Mangifera sylvestris altera, Herk. Amb. i. 97.
   Habitat in Amboina et Insulis vicinis.

Caput XXIII.

Manga fœtida, p. 98, t. 22.

On the authority of Loureiro this has been described in the Encyclopedie (Sup. iii. 583) under the name of Mangifera *fœtida*. The acrimony of the juice, in its bark, shews a strong affinity with the genus which I called Holigarna, a name adopted by Dr Roxburgh (Hort. Beng. 22).

Caput XXIV.

Durio, p. 99, t. 29.

This is the Durio *zibethinus* of modern botanists. The species mentioned by Rumphius are merely such varieties as occur in plants much cultivated.

Caput XXV.

Saccus arboreus major, p. 104, t. 30.

I think there can be no doubt that this is the same with the Tsjaca *maram* of the Hortus Malabaricus. I know no tree better, and every word that Rumphius says, so far as I can judge, I consider applicable to the common Jaca tree of India. Notwithstanding this, Willdenow, for his Artocarpus *integrifolia*, does not quote this account, which, in my opinion, is better than that of Rheede; and the Compilers of the Encyclopedie consider it as a distinct species, calling it Artocarpus *heterophylla*, while the Tsjaca *Maram* they call A. *Jaca*. It is true, that they quote this plant of Rumphius with doubt, and therefore their A. *heterophylla* may be a real species: but I would observe, that, some of the leaves being entire and others lobed, is no proof whatever of a distinct species; all the species of Artocarpus that I know, the Bread-fruit excepted, having the leaves on their young plants lobed, while those on the

adult plants are entire. The names *integrifolia* and *heterophylla* are therefore ill applied to any particular species.

If, however, the Artocarpus *heterophylla* be really a distinct species, the plant of Rumphius is wrong quoted in the Encyclopedie (iii. 209), and I have no doubt is identically the same with the Tsjaca *Maram* of the Hortus Malabaricus (iii. 17, t. 26, 27, 28); nor does it form even a variety, as Willdenow would have it (Sp. Pl. iv. 189). The different species mentioned by Rumphius are the real varieties which occur in this, as well as in all other plants, that are much cultivated.

Burman, in his observation on this plant, I suppose, is in an error, when he refers to the Waal *mendya* of Herman as being the same. I believe there can be little doubt of the Waal *mendya* being the Grewia *orientalis* (Lin. Fl. Zeyl. 324). In the Supplement to the Encyclopedie (v. 619) is some farther account of this tree, under the name Choopada. The proposal of Gærtner and Commerson to place this tree in a separate genus from the Bread-fruit-tree seems to me unnecessary, and to rest upon circumstances too minute, where the number of species is moderate, the plants nearly resembling each other in general appearance, and the characters distinguishing from other genera clearly marked.

Caput XXVI.

Saccus arboreus minor, p. 107, t. 31.

The Compilers of the Encyclopedie (iii. 210) consider this as a variety of the Artocarpus *Jaca*, in which they are followed by Willdenow (Sp. Pl. iv. 189); but there is reason to think that it is a very distinct species, the pubescence on the leaves, and the different forms of the amenta, being sufficient marks of distinction. I have, however, never seen any plant that I could refer to this species.

It must be observed, that Willdenow considers the Rademachia *integra* of Thunberg as the same with the Tsjaca *naram* of Rheede, which, as I have said, is the Saccus *arboreus major* of Rumphius; while the Compilers of the Encyclopedie (iii. 210) consider it as the same with the Saccus *arboreus minor*, and as being the original Artocarpus *integrifolia* of the younger Linnæus.

Saccus arboreus minor alterus, p. 108.
Saccus arboreus minor tertius, p. 108.

From the short notices given of these plants in the text, it is impossible to say whether or not they should be considered as varieties, or as species. In plants, however, so little cultivated as these would seem to be, the latter opinion is the most probable.

Angelyquen vel Caju Bandaa, p. 109.

Burman in his observation wonders that Rumphius should have confounded his Saccus *arboreus minor* with the *Ansieli* of the Hortus Malabaricus (iii. t. 32); but he seems to have read no more of Rumphius than the title of the chapter, for the latter nowhere says any such thing. Towards the end of the chapter, after having described three kinds of the Saccus *arboreus minor*, he proceeds to state, that, in Malabar, there is still another kind of Saccus *arboreus*, with a small fruit, which is there called Angelyquen; and afterwards, in an appendix, he adds, that the same kind is found in Java, where it is called Caju Bandaa, and that it is the same with the Ansieli of the Hortus Malabaricus. Now, this is a very distinct species, which the Compilers of the Encyclopedie (iii. 210) called Artocarpus *hirsuta*. Willdenow chose (Sp. Pl. iv. 189) to call this plant Artocarpus *pubescens*, quoting the Encyclopedie with

doubt, but the Hortus Malabaricus without reserve. Why he did so, I cannot exactly say. He indeed calls the leaves "subtus pubescentia," while the Compilers of the Encyclopedie call them "inferne aspera;" but in this they are completely justified by Rheede, who says "folia inferne aspera et manui tangenti adhærentia." Both authors, I suspect, have fallen into an error, copying from the drawing of Rheede, and attributing to the plant "amenta mascula pendula." Neither Rheede nor Rumphius mention this circumstance, and the appearance in the plate I consider as originating in the specimen, from which the drawing was taken, having been kept until the parts became somewhat flaccid.

In 1801, I found a tree in Malabar, and the adjacent territory, which I have scarcely any doubt is the Ansieli; and I took specimens and a drawing, which in 1806 I gave to Sir J. E. Smith, and the following description was taken on the spot.

Artocarpus hirsuta, Enc. Meth. iii. 210.

Artocarpus pubescens, Willd. Sp. Pl. iv. 189.
Caju Bandaa vel Angelyquen, Herb. Amb. i. 109.
Ansieli, Hort. Mal. iii. 25, t. 32.
Heb Helasu Carnatæ.
Aiony Malyalæ, Buchanan's Mysore, ii. 436.

Habitat in Malyalæ sylvis et ad pagos.

Arbor inter altissimas, lintribus conficiendis apta. Rami teretes, lactescentes, ad folia annulo cincti, pilis fuscis appressis hispidi. Folia alterna; in adulta planta magnitudine Artocarpi integrifoliæ foliorum, margine revoluto integerrima, integra, nervis supra depressis costata, venosissima, supra nitida, subtus nisi ad costas hispidas glabra: in plantis junioribus maxima, incisa. Petiolus brevissimus, depressus, pilis fuscis appressis hispidus. Stipulæ gemmaceæ, caducæ, hispidæ, geminæ, ut in affinibus dispositæ.

Pedunculi axillares plerumque gemini, erecti, teretes, hispidi, petiolo duplo longiores, ebracteati, uniflori. Masculinum amentum teres, longitudine folii erectum, undique floribus imbrica-

tum. Fœmininum sæpe in eadem cum masculino axilla positum, magnitudine nucis juglandis globosum.

M. Calyx monophyllus, cyathiformis, ore irregulari dehiscens. Filamentum unicum, teres, calyce duplo longius. Anthera parva, rotunda.

F. Germina plurima, teretia, pilosa. Styli brevissimi. Stigmata acuta.

Fructum non vidi.

In the part of the country north from Malabar, I found a tree very nearly allied to that above described, and, in Tulava, called Pe Jaca; but I did not see any part of its fructification. Its leaves were very scabrous above, and very slightly indented on the edges. Notwithstanding this, I am, however, inclined to think, that it may be the same with the Chama of the Bengalese, which I found on the hills near Goyalpara, and which is probably the same with the Chaplasha of Chatigang, which I sent to Dr Roxburgh in the year 1798, but of which I preserved no description. The following is an account of the Chama.

Artocarpus Chama foliis plantæ adultæ integris, subrotundis, basi emarginatis, utrinque hispidis; amentis masculinis orbiculatis, compressis.

Artocarpis Chaplasha, Hort. Beng. 66?
Chama Bengalensium.
Habitat in Camrupæ orientalis sylvis.

Arbor excelsa, lactescens. Ramuli teretes, annulati, hispidi. Folia decidua, alterna, subrotunda, basi profunde emarginata, mucronata, integerrima, utrinque hispida, supra et scabra, costata, reticulatissima: plantis junioribus maxima, pinnatifido-sinuata, serrata. Petiolus brevissimus, depressus, hispidus. Stipulæ gemmaceæ, geminæ, carinatæ, deciduæ, pilis sericeis pubescentes, foliis in gemmæ conduplicatis.

Pedunculus masculinus, quatenus ego vidi, ex axilla folii anni præteriti, unde facie infrafoliaceus, flore multo longior, teres, solitarius, hispidus, erectus. Amentum suborbiculatum, magnitudine cerasi compressum. Pedunculus fœmininus masculino similis, amento subrotundo compresso obliquo.

Caput XXVII.

Soccus lanosus, p. 110, t. 32.

Willdenow (Sp. Pl. iv. 188) calls this Artocarpus *incisa* β, considering it as a cultivated variety of the following plant; and in the Encyclopedie both are quoted, without distinction, for the Artocarpus *incisa* (iii. 207), while the Soccus *sylvestris* is considered the variety β: but these suppositions seem to me devoid of foundation, and I agree with Rumphius in considering the three species distinct. This is distinguished by its smooth leaves; and Rumphius enumerates several different kinds, some of which are spontaneous, but still different from the Soccus *sylvestris* or Soccus *granosus*. These kinds are, however, I think, to be considered as varieties, arising as usual from cultivation. See Sookoon, under the head Choopada (Suppl. v. 619) in the Encyclopedie.

Caput XXVIII.

Soccus granosus, p. 112, t. 33.

This, as mentioned in the Commentary on the foregoing plant, is the Artocarpus *incisa* α, of Willdenow (Sp. Pl. iv. 188), from which it may readily be distinguished by having its leaves scabrous above, and woolly beneath. Of this also Rumphius enumerates both cultivated and spontaneous varieties,—a proof of its being a species really distinct from the preceding.

Caput XXIX.

Soccus sylvestris, p. 114, t. 33.

The Compilers of the Encyclopedie (iii. 208) call this Artocarpus *incisa* β; but they suspect that it may be a distinct species, in which I entirely agree with them. Its

leaves are so bristly that they can scarcely be handled, or even touched.

Soccus sylvestris celebica, p. 115.

This is evidently an Artocarpus, with entire leaves, which, together with the footstalk and fruit, are covered with hairs. It may very possibly be the same with the Artocarpus *Lacucha* of Dr Roxburgh (Hort. Beng. 66), a tree very generally diffused over India. The account given by Rumphius is too imperfect to admit with certainty of the plant of Celebes being considered the same with the Lacucha; but he says nothing to contradict this opinion, as will appear from the following description of the Lacucha taken by me in Ava during the year 1795, from whence I sent specimens, now in the collection of the late Sir Joseph Banks.

The tree is called *Lacucha* in the Sanskrita, *Baral* in the Hindwi, *Dephal* in the Bengalese, and *To Pi-nœh*, or Wood-Jaca, in the language of Ava.

Arbor mediocris. Ramuli viridescentes, pilis fuscis dense tecti, lactescentes. Folia alterna, internodiis multo longiora, ultra 6 pollices longa, oblonga, basi cordata, cum acumine brevi obtusa, denticulis parvis remotis serrata, utrinque hispida, supra nitida, venis reticulata, costata. Petiolus brevis, teres, villosus. Stipulæ gemmaceæ, geminæ, subulatæ, caducæ, villosæ, petiolo dimidio breviores.

Amenta masculina magnitudine fabæ arvensis pedicellata, axillaria, plerumque gemina.

Fructus subrotundus, magnitudine pugni, forma irregularis, flavescens, cortice tenui pubescenti rudimentis stigmatum notato sed non areolato tectus, succo lacteo scatens, pulposus. Semina ovata, compressa, albida, arillo carnoso tecta, receptaculo centrali lignoso tereti insidentia.

Soccus sylvestris fœmina, p. 15.

This also is undoubtedly an Artocarpus; but I have seen nothing resembling it.

Caput XXX.

Prunum stellatum angulosum, p. 115, t. 35.

This fruit was noticed by very early botanical writers; but seems very inferior in ancient India, where I have seen it, to what it would seem to be in the Indian Archipelago, as described by Rumphius. Rheede (Hort. Mal. iii. 51, t. 43 & 44) gives a good account of it, as found in ancient India. Plukenet then mentions it in two places; first, (Alm. 238) under Ray's name, "Malus Indica pomo anguloso Carambolas dicta;" and, secondly, (Mant. 36), under the name of "Carambola, Malabarorum Tamaratonga Horti Malabarici." The elder Burman (Thes. Zeyl. 148) calls it "Malus Indica, foliis sennæ occidentalis, fructu acido, pentagono, sulcato, floribus rubris." He also gives the synonyma of preceding authors with tolerable care; and mentions the true Indian name, *Kama-ranga*, derived from *Karma-ranga* of the Sanskrit; but his explanation of this name is totally absurd. The description of Rumphius comes next in order, and is excellent. The sweet and sour kinds mentioned by him are varieties, such as occur in all plants much cultivated. Linnæus, in publishing the Flora Zeylanica, established the genus Averrhoa, and made this one of the species (178), as is usual in that work, quoting the synonyma with admirable care. In the Species Plantarum it obtained the specific name *Carambola*, and continues to be called by this appellation in all subsequent authors of note; yet this name is of very doubtful origin. It is true, that Rheede asserts it to be the name in use with the Brahmans of Malabar; but he adds also, and with the Portuguese, a coincidence that would be remarkable; but the Sanskrita name is *Karma-ranga*, in the vulgar dialects of the north corrupted into *Kama-ranga*, a name which extends from the Ganges even to Ceylon; and I suspect

that even the Tamaratonga, which Rheede says is the vulgar name in Malabar, is a mere corruption, by errors in copiers and printers, of the same word. As for Carambola, it is, I suspect, one of those productions of careless travellers, which are considered as Indian words by Europeans, and as European words by the Indians.

Caput XXXI.

Blimbingium teres, p. 118, t. 35.

The synonyma of older authors may be found in the elder Burman (Thes. Zeyl. 147), and in the Flora Zeylanica of Linnæus (177). This great author, in his Species Plantarum, called it Averrhoa *bilimbi*, preferring the uncouth name of Rheede, corrupted from the Malay; while Rumphius afforded two good specific names, *stellatum* and *teres*, for the two species of Averrhoa, which he described. The names of Rheede, however, continue to be used by all recent authors of note.

Caput XXXII.

Jambosa domestica, p. 121, t. 37.

This is undoubtedly the Eugenia *Malaccensis* of all botanists since the time of Linnæus; and, for what I have to say on the subject, I may refer to my Commentary on the First Part of the Hortus Malabaricus, (Lin. Trans. xiii. 481). I have here, however, to add, that this fruit, in its native country, the Eastern Archipelago, has a superior quality to what it possesses as an exotic in ancient India. I believe also, that all the kinds mentioned by Rumphius, even the Jambosa *calapparia* (p. 122), are merely such varieties as occur in all plants that are much cultivated.

Jambo d'Agoa Rosada, p. 123.

This, as I have mentioned in the Commentary on the Hortus Malabaricus (l. c.), seems to me the Eugenia *Jambos*, the Portuguese name being a mere translation of Gulab Jamba, the Hindwi name of this fine tree. Burman's observation on the Jambosa *domestica* (p. 124) is full of errors, mentioned in my Commentary on the Hortus Malabaricus, Part i. p. 27.

Caput XXXIII.

Jambosa nigra, p. 125, t. 38, f. 1.

This is quoted by Willdenow (Sp. Pl. ii. 959), along with the former, for the Eugenia *Malaccensis;* but it seems a distinct species, and, without being certain, I believe that it is the Eugenia *purpurea* of the Hortus Bengalensis (p. 35), introduced there by Mr Colebrooke, who, I suppose, gave it this name, which I find in no botanical writer. The plant of Rumphius is not, however, quoted in the Hortus Bengalensis. The observation of the elder Burman, at the end of this chapter, is, in my opinion, totally erroneous, no one of the plants quoted being the same.

Caput XXXIV.

Jambosa aquea, p. 126, t. 38, f. 2.

In the Encyclopedie (iii. 200) this is quoted with doubt for the Eugenia *Javanica;* but as the fruit of the latter has not been described, nothing certain concerning this question can be determined. In the Hortus Bengalensis (37), without quoting Rumphius, this elegant species has been called Eugenia *aquea*. It was brought, along with the preceding, by the fleet of Admiral Raynier, after the capture of Amboina; and, in the year 1800, I saw both in the

garden of the late worthy Dr Anderson, at Madras. The Bengalese name given to the Jambosa *aquea* is perfectly generical, and it has been called Jamb by the gardeners, just as any foreign species of Quercus might by a common labourer be called Oak. Considering the deserved high authority of this work respecting the native names of plants, I think this explanation necessary; as a Bengalese name might imply the plant being a native of that country. The kind with a white fruit, mentioned by Rumphius, seems a mere variety, the effect of cultivation.

Caput XXXV.

Jambosa silvestris alba Utan Puti, p. 128, t. 39.

In my Commentary on the Hortus Malabaricus (P. i. fol. 27), I have mentioned the mistake into which modern botanists have fallen, in quoting this for the Eugenia *jambos*. I have no doubt of its being a totally different species, which hitherto has not been properly applied to any plant recently described.

Jambosa silvestris alba Biawas, p. 128.

It is impossible to say, from any thing mentioned by Rumphius, whether this should be considered as a distinct species, or as a mere variety of the foregoing. If Burman was wrong in comparing these two plants to the Malacca *Schambu* of Rheede, which is at least of the same genus, he erred much more in comparing them to the Catu *Tsiambu* (Hort. Mal. iv. t. 8), which does not seem to belong to the same family.

Jambosa silvestris parvifolia, p. 129.

In the Actuarium or Appendix to this Work (cap. 6) we are informed that a transposition of plates has taken

place; and that the plate representing this Jambosa is given in vol. ii. tab. 40; while the 40th plate of this first volume represents the Radix Deiparæ spuria, described in vol. ii. p. 127. After this we can only account for the Jambosa *silvestris parvifolia* being quoted for the Gmelina *Asiatica* in Willdenow (Sp. Pl. iii. 313), by supposing, that he looked merely at the drawing, without reading the description. The Compilers of the Encyclopedie (ii. 739) noticed the discrepancy between the description and figure prefixed, but do not seem to have consulted the Actuarium, so as to refer the figures to their proper places. I have no doubt of the Jambosa *silvestris parvifolia* being an Eugenia, and cannot see any resemblance between it and the Blatti of the Hortus Malabaricus (iii. t. 40), or Soneratia *acida*, with which Burman in his observation compares it.

Jambosa silvestris Jamboe Ayer Utan dicta, p. 129.

When in the north-west parts of Mysore, in the cool moist woods bordering on the lower sea-coast, I observed a tree which seemed to have a great resemblance to this plant of Rumphius; only, from not having seen the fruit, I remain doubtful. I shall, however, describe what I saw, of which Sir J. E. Smith has the specimens that I brought home in 1806.

Eugenia læta foliis ellipticis, acuminatis, non punctatis; pedunculis unifloris terminalibus, subgeminis.

Habitat in Carnatæ occidentalis sylvis.

Arbuscula ramis teretibus, glabris. Folia opposita, elliptica, acuminata, integerrima, glabra, absque nervo marginali subcostata, venosa. Petiolus brevissimus, estipulaceus.

Pedunculi terminales, sæpius gemini, uniflori, petiolo multoties longiores, incrassati, in medio articulati, nudi. Flores magni, squamula ad calycis basin bracteati, staminibus incarnatis albi.

Calyx quadripartitus laciniis subrotundis. Petala quatuor, calyce multo majora, subrotunda, caduca. Stamina plura, perigyna, petalis longiora. Germen inferum, oblongo-turbinatum. Stylus unicus.

What Rumphius says of a verruca growing below the leaves, and spreading out into a substance resembling the Cupressus *marinus*, seems either to relate to some Viscum or Psilotum, or to some disease similar to that which we observe in Europe on the Betula *alba*.

Caput XXXVI.

Jambosa ceramica, p. 130, t. 41.

Linnæus, in the Flora Zeylanica (182–186), described as species of Myrtus five plants, which he acknowledges scarcely belong to that genus, and which should rather be considered as forming one, that should be called Myrcia, and of which he gives the natural characters at full length. More modern botanists have availed themselves of this hint, and Swartz adopted this genus, but chose to give it the hard Greek name Calyptranthes. One of these five plants, which Linnæus at first (Fl. Zeyl. 185) called Myrtus *foliis lanceolato-ovatis*, he afterwards, in the Species Plantarum, called Myrtus *cumini*. The synonyma, which Linnæus quoted for this, were, the Arbor *Zeylanica cuminum rĕdolens* of the elder Burman (Thes. Zeyl. 27), and the *Ankaenda* of Herman (Mus. Zeyl. 23). We are indebted to the late Dr Dryander (Linn. Trans. ii. 232) for having here pointed out an error in Herman; and that in his Herbarium the tickets of the Madan and Ankaenda must have been changed. The synonyma, therefore, of Linnæus are totally wrong, as he described the plants of Ceylon from the collection of Herman. The Arbor *Zeylanica Cuminum redolens* and the *Ankaenda* belong therefore to the Jambolifera of Linnæus (Fl. Zeyl. 139); while the Prunus *In-*

dica fructu nigro (Burm. Thes. Zeyl. 197), the *Jambulones* (C. B. P. 466), the *Jambolous* (Acost. Aromat. 209), and the *Madan* (Herm. Mus. Zeyl. 8), are really the plant (Fl. Zeyl. 185) which Linnæus afterwards called Myrtus *Cumini*. As the generic name Jambolifera, and the specific name Cumini, are thus totally founded in error, Gærtner has done perfectly right in changing the former to Cyminosma (De Sem. i. 280, t. 58, f. 6); and Willdenow should have transferred all the synonyma, given by mistake in the Flora Zeylanica, to the Calyptranthes *Jambolana*, which, without any doubt, is the same plant with the Myrtus *Cumini*. An unfortunate error, however, in the younger Burman, has led Willdenow into still greater mistakes. The former quoted, as synonymous with the Myrtus *Cumini*, the Jambosa *ceramica*, of which I am now treating; and the latter, joining this with some of the synonyma which Linnæus by mistake had given to the Jambolifera or Cyminosma, made it into a species, which he called Calyptranthes *caryophyllifolia*, a name which he borrowed from a mistake in the Encyclopedie. In this valuable work (iii. 198), the Perin *Niara* of the Hortus Malabaricus (v. 57, t. 29) is considered as different from the Jambolana described by Rumphius in the next chapter, because the painter of the latter, in attempting awkwardly to represent the leaves in proper perspective with their points bending a little backward, "folia rotundo terminantia cum brevi apice, quæ deorsum inflectitur," has represented them as deeply emarginated; but, on a careful examination of the descriptions of both authors, with a tree most perfectly known to me, I have not the smallest doubt that the Perin *Niara* and Jambolana are quite the same, and that Willdenow is wrong in referring the Jambosa *ceramica* to this species. In the Encyclopedie, it is considered, with some doubt, as belonging to the Eugenia *cymosa* of that work

(iii. 199). This doubt arises from its having been quoted as the Myrtus *Cumini* of Linnæus; but the deep division of the calyx, very evident in the figure of Rumphius, and his having described the real Myrtus *Cumini* under the name Jambolana, removes all doubt from my mind. I think that, in the woods of Chatigang and Goyalpara, I have seen the tree; but as I have not seen the fruit, I am uncertain, in a genus the species of which are so difficult to determine. In 1798 I sent specimens to Sir Joseph Banks, under the name of Eugenia *calyptrata*, and I now shall mention what I quoted on the spot.

Eugenia cymosa, Enc. Meth. iii. 199.

Jambosa ceramica, Herb. Amb. i. 130, t. 41.

Bara Jamba Bengalensium.

Habitat in Camrupæ, Tripuræ, et Indiæ aquosæ sylvis.

Arbor mediocris. Folia magna, coriacea, ovalia vel ovata, sæpius utrinque obtusa cum acumine ad apicem obsoleto, costata, venosa, costis et venis sensim evanescentibus, odore aromatico.

Paniculæ ex anni præteriti ramulo infra folia nova enatæ ramis tetragonis.

Calyx quadrilobus. Petala quatuor, apicibus acutis conniventibus intra stamina incurva insertis, simul caduca, operculum peltatum mentientia.

Fructum non vidi, sed dicitur malum magnitudine æquare.

Jambosa silvestris Lahunensis, p. 130.

This seems evidently to be an Eugenia; but I know nothing farther of it than is here mentioned by Rumphius.

Caput XXXVII.

Jambolana, p. 131, t. 42.

Most of what I had to say concerning this plant has been anticipated in the Commentary on the Jambosa *ceramica*. It now remains to give what I consider the true synonyma, and a description; and I must do justice to Burman in

stating, that the synonyma which he gives to this plant seem correct.

Eugenia Jambolana, Enc. Meth. iii. 198; Hort. Beng. 37.

Eugenia caryophyllifolia, Enc. Meth. iii. 198.
Calyptranthes Jambolana, Willd. Sp. Pl. ii. 975; Hort. Kew. iii. 191.
Calyptranthes caryophyllifolia, Willd. Sp. Pl. ii. 975, exclusis synonymis Rumphii et Burmanni.
Myrtus Cumini, Burm. Fl. Ind. 115, exclusis synonymis Rumphii et Burmanni.
Myrtus foliis lanceolato-ovatis, Lin. Fl. Zeyl. 185, exclusis synonymis.
Prunus Indica, fructu nigro, Olivæ magnitudine, Jambulous Acostæ, Madan Zeylonensibus, Burm. Thes. Zeyl. 197, exclusis synonymis Plukenetii, Sloani, et Rayi.
Jambolana, Herb. Amb. i. 131, t. 42.
Caryophyllus, languescente vi aromaticus, Malabarensis folio et fructu maximo, Pluk. Alm. 88; Phyt. t. 274, f. 2: Mant. 39.
Perin Niara, Hort. Mal. v. 57, t. 29.
Jati Jam Bengaliensium.
Jamun Hindice.
Habitat ubique ad Indiæ pagos.

Arbor mediocris. Folia rigida, oblonga, basi sæpius obtusiuscula, apice reflexo plerumque acuminata, venis parallelis in venam submarginalem desinentibus, reticulata, poris minutis perforata, odore languido aromatico amara. Petiolus quartam folii partem longitudine attingens, obtusangulus.

Paniculæ nunc axillares, tunc terminales, sæpius tamen in ramuli parte foliis nudata.

Calyx truncatus. Bacca Olivæ magnitudine utrinque obtusa, sed apicem versus sæpius crassior, umbilico profundo rimo semper obliquo coronata, nigra, monosperma. Caro crassa, succo tingente scatens, ex purpurascente alba. Receptaculum nullum. Semen oblongum, utrinque obtusum, bacca multoties minus. Integumentum crustaceum, friabile. Albumen nullum. Cotyledones crassæ, hinc planæ, inde convexæ, transversæ. Radicula unum latus versus inter cotyledones nidulans.

In the woods of Behar, or Magadha, I found a tree differing in no respect from the above description, except that

the fruit was much smaller, and the leaves sharp towards the footstalk. It was called Janggali (sylvestris) Jamun (Myrcia) by the natives, and I consider it as the spontaneous kind of this species, while the large fruit I consider as the effect of cultivation. It must be observed, that the name Janggali *Jamun* is given also to another species, which I call Calyptranthes *tenuis*, although I think Myrcia *tenuis* would be a more Linnæan and proper denomination.

Caput XXXVIII.

Mangostana, p. 132, t. 43.

This is the Garcinia *Mangostana* of all modern botanists.

Mangostana celebica, p. 134, t. 44.

Linnæus, in the first edition of the Species Plantarum, called this Garcinia *celebica*, and was imitated by Burman (Fl. Ind. 109), Willdenow (Sp. Pl. ii. 848), and the Compilers of the Encyclopedie (iii. 700). Loureiro having observed that the flower of the Folium *acidum majus* of Rumphius (iii. 58) differed somewhat from that of the *Mangostana*, established it for a new genus, which he called *Oxycarpus*. It was afterwards discovered by M. du Petit-Thouars, that the Garcinia *celebica* belonged to the same genus; but he chose to give this a new name, *Brindonia*, from *Brindones*, the appellation by which Garcias, John Bauhin, and other old botanists, knew its fruit. This innovation the Compiler of the Supplement to the Encyclopedie (iv. 258) properly rejects, and calls the plant Oxycarpus *celebica;* but he rejects all the synonyma of these ancient authors, transferring them to the Oxycarpus *indica*. This he has done with great propriety, because the Mangostana *celebica* has a white juice, while that of the

Mundo and Brindonia is yellow, changing into an imperfect gamboge.

In the woods, south from the Ganges in Magadha, I have found a tree, which, as its fruit has only four seeds, I should have taken to be the Brindone; but the juice of the tree is limpid, or white, like that of the Mangostana or Oxycarpus *celebica;* and the figure and account given by Rumphius of this agree so well with the Gangetic plant, that I should have considered them as the same, did it not appear clear that the Mangostana *celebica* is dicœcious, having male-trees that produce no fruit. This, so far as I know, is not the case with the Gangetic plant, which produces both male and hermaphrodite flowers on the same stem. It may, however, have trees producing male flowers alone, although such escaped my notice in travelling; for I found the tree in no other place. I shall here, however, describe it as the Oxycarpus *gangetica*, leaving it to be determined by farther observation, whether or not it be really distinct from the Oxycarpus *celebica.*

Oxycarpus Gangetica foliis lanceolatis, floribus in eadem arbore masculinis et hermaphroditis, bacca tetrasperma.

Habitat in Magadhæ sylvis.

Arbor magna. Ramuli glabri, teretes, succo aqueo scatentes. Folia opposita, lato-lanceolata, utrinque acuta, glabra, nitida, integerrima, uninervia, venosa, acida. Petiolus brevissimus, glaber, marginatus. Stipulæ nullæ.

Flores parvi, flavi, monoici. Masculini laterales, hermaphroditi terminales. Pedunculus flore brevior, teres, glaber, uniflorus; hermaphroditus solitarius.

M. Calyx tetraphyllus foliolis ovalibus, concavis, coloratis, exterioribus duobus minoribus. Petala quatuor, erecta, ovata, obtusa, calyce longiora. Receptaculum centrale tetragonum, antheris angulatis subsessilibus tectum.

H. Calyx et corolla ut in Masculo. Filamenta quatuor, multifida. Antheræ plures, angulatæ. Germen utrinque attenuatum, apice quadrisulum, quadriloculare. Stylus brevissimus. Stigma quadrilobum, lacerum.

Maturum fructum non vidi: immaturus succi flavi pauxillo tantum præditus.

Very nearly allied to the above is another tree, which I have seen at Goyalpara, which the natives call Sopsopiya, and which has a fruit that is not very bad for eating. Of this also I shall here give some account, although I have not seen the flower.

Oxycarpus? Sopsopia foliis ellipticis obtusis, baccis oblongis 4 seu 5 locularibus, pedunculis multifloris.

Sopsopiya Bengalensium.
Habitat in Camrupæ sylvis.

Arbuscula ramulis glabris, compressis. Folia elliptica utrinque obtusiuscula, costata, venosa, glabra, acida cum amaritudine quadam. Petiolus teres, marginatus, brevissimus, estipulaceus.

Pedunculi terminales, gemini, tetragoni, articulati baccas gerunt tres vel quatuor cum aliorum rudimentis, unde forte flores sunt duorum parium lateralium cum quinto terminali.

Bacca lævis, fructus juglandis magnitudine oblongiuscula, stigmate peltato orbiculato crenato coronata, calyce minimo tetraphyllo insidens. Foliola obtusa alternis minoribus. Cortex in fructu maturo tenuis, intus ramentaceus, membranaceus; in immaturo succo flavo turgidus, coriaceus. Loculi 4 seu 5 pulpo sapido farcti, dissepimentis interjacentibus tenuissimis ramentaceis. Receptacula nulla. Semina solitaria, oblonga, compressa, hinc obtusa, inde angustiora, sinu hinc extremitatem versus crassiorem excavata. Integumentum duplex: exterius membranulis intertextis pulpo repletis farctum; interius tenue, semini adhærens. Seminis substantia alba, carnosa, firma, in qua nullam ferruminationem, embryonem, radiculam, neque aliam ullam partium divisionem perspicere possum.

Arbor Mundo dicta, p. 135.

Rumphius, in the text, considers the Mundo as the same with, or at least very nearly allied to, the Panitsjica of the Hortus Malabaricus (iii. 45), which Burman in his observation on the Mangostana (p. 134 *ad initium*) considers very nearly allied to that tree, and the same with the Man-

gostana *celebica*. Burman is certainly wrong, for there can be no doubt, I think, that the Panitsjica is a Diospyros, which Gærtner, mistaking the position of the calyx, called Embryopteris. Further, what Rumphius states concerning the juice of the Mundo, which he says is yellow, is by no means reconcilable with the Panitsjica, the juice in the unripe fruit of which is, as Rheede expresses it, "humor glutinosus aqueo pellucidus." I am, however, inclined to think, that the Mundo, although quite different from the Panitsjica, is really of the same genus with the Mangostana *celebica*; for I know a tree, which I take to be the Mundo, and which Dr Roxburgh for some time took to be the Garcinia *celebica*, but which, on farther consideration, he called Garcinia *pictoria*. I found it in a garden at Baruipur, where it probably had been imported from abroad, and sent it to Dr Roxburgh in 1799. I also sent a description and drawing to Sir J. E. Smith, coloured with its own gum, that is, the flowers were coloured entirely with this substance, while indigo was added for the green parts. This pigment is, however, very different from true gamboge, being less readily soluble in water, and its colour remaining unchanged when mixed with potass. I am inclined, however, on account of this yellow juice, to think, that this is the Kanna Gorakha of the Cingalese, or the Carcapuli of Linscot, which Caspar Bauhin, and after him Burman (Thes. Zeyl. 27), Linnæus (Fl. Zeyl. 195), and the Compiler of the Encyclopedie (iii. 701), confounded with the Carcapuli of Acosta, or Gorakha of the Cingalese, as Hermans, in a letter to Syen (Hort. Mal. i. 42), clearly points out. Although Burman says (Thes. Zeyl. 28) that the fruit of his plant has only four seeds, and although this number of seeds is found in what I have called Oxycarpus *gangetica*, and a greater number in that which I am now describing, yet the juice of the Oxycarpus *gangetica* is not

a yellow pigment; and the number of seeds, owing to abortion, is very variable, a circumstance little attended to by many of the older botanists. I have, at any rate, very little doubt that the Garcinia *tinctoria* of Dr Roxburgh is the Oxycarpus *indica* of the Encyclopedie (Sup. iv. 257), although the Compiler says that the hermaphrodite-flowers are solitary. This, indeed, is sometimes the case in the plant which I saw; although, in more perfect specimens, three, or even five, flowers at the end of the branch are more common. The flowers are also said by the Compiler to be small; but this is by no means the case with the tree seen by me, and which I shall therefore describe, as being the Mundo.

Arbuscula erecta ramis confertis, lævibus, deflexis. Folia opposita, petiolata, lanceolato-oblonga, integerrima, acuminata, glabra, venosa, plana, pollices quatuorlonga, sesquipolicem lata. Petiolus compressus, supra planus, marginatus, brevissimus, glaber, estipulaceus.

Flores dioici polygami, magni, flavi, terminales, fasciculati, squamis vagis ovatis obtusis concavis brevibus bracteati. In masculina arbore fasciculus justus constat e pedunculo centrali trifloro, cum lateralibus unifloris sex, sed flos unus vel alter sæpe deficit; in hermaphrodita arbore justus fasciculus habet pedunculum centralem uniflorum cum duobus vel quatuor lateralibus, sed laterales aliquando deficiunt.

M. Calyx tetraphyllus, coloratus, foliolis subrotundis, concavis, obtusis, patulis, alternis majoribus carinatis. Petala quatuor, assurgentia ovalia, carnosa, calyce duplo longiora margine tenuissimo reflexo. Filamenta plurima, crassa, brevissima, receptaculum undique tegentia. Antheræ clavatæ, tetragonæ. Pistillum nullum. Receptaculum superum, maximum, convexum, quadrilobum.

H. Calyx et corolla ut in masculinis. Filamenta quatuor, petalis alterna, brevia, 3–7-fida, ramis antheriferis. Antheræ oblongæ, nescio an fertiles! Germen subrotundum, magnum, superum, striis depressis 9–12 notatum, 9–12 loculare. Stylus brevissimus. Stigma maximum, peltatum, 9–12 lobum, lobis laceris.

Caput XXXIX.

Anona, p. 136, t. 45.

Rumphius considered this as the same with the Anona *Maram* of the Hortus Malabaricus (iii. 23, t. 30, 31); and the elder Burman, in his observation on this chapter, although he admits that the figures are somewhat different, persists in the same opinion, adding, as synonymous, the Anona *maxima*, "foliis oblongis angustis, fructu maximo, luteo, conoide, cortice glabro, in areolis distincto" of Sloane, which is the Anona *Oviedi* of Clusius, Parkinson, and J. Bauhin, and which is also quoted by Catesby and Ray for a plant described by them. Burman also added as synonymous the Anona *indica angustifolia*, "fructu cœruleo, cortice squamato glabro" of Plukenet (Alm. 32; Phyt. t. 134, f. 4). Now, I see no very great objection to the first set of synonyma, although Rumphius alleges, that the plant of Oviedo differs much from his; but the plant of Plukenet, having a blue scaly fruit, cannot be that of Rumphius, having a yellowish or reddish fruit, like a pomegranate in colour. The plant of Plunkenet may, however, be the same with that of the Hortus Malabaricus, of which "fructus non, uti Atamaram, e compactile lignosarum squamarum strue compositi, sed undique glabro, hyacinthino ac tenui nitente cortice obducti sunt." If by this Rheede means that the fruit is purple, like a hyacinth, such a plant is totally unknown to me. In other respects, his account of the fruit agrees very well with that of a plant very common in India, and which I take to be the Anona of Rumphius, although I must confess that its fruit does not exactly resemble either that delineated in the Herbarium Amboinense, or Hortus Malabaricus; nor do the figures of the fruit, in these two works, resemble each other.

It must also be observed, that Rumphius himself doubted of his plant being the same with the Anona of Oviedo, which Plukenet says (Alm. 32) is the Cachima of the Caribbæan Islands, that is, the Anona *muricata*.

When the elder Burman published his Thesaurus Zeylanicus, he considered it likely (21) that the plant of Rumphius is the same with the Anona *sylvestris* of Herman, or Ahughas of the Ceylonese (misprinted Alughas in Burman, a way of spelling carefully since copied), an indigenous plant, now called Anona *asiatica* (Willd. Sp. Pl. ii. 1267); but since Linnæus first introduced the species (Fl. Zeyl. 225), several synonyma have been added, and especially the Guanabanus *fructu purpureo*, an American plant, very possibly the same with the Anona of the Hortus Malabaricus. I must admit, that the plant, which I consider as the one meant by Rumphius, is chiefly found about villages, and may therefore perhaps be an exotic, while the name Nona, by which it is usually called in the Gangetic provinces, savours much of being derived from Anona, a Mexican word, as Rumphius alleges: yet the plant, according to him, differs so much from the descriptions of the American Anona, that I am inclined to think it indigenous, and that it may be the Anona *asiatica*, as constituted by Linnæus (Fl. Zeyl. 225). This I judge to be the case, the more especially, because it is much more generally diffused than the Anona *squamosa*, no doubt an American plant; while its fruit is execrable, and totally unworthy of transportation, and that of the Anona *squamosa* is delicious.

However this may be, Linnæus, in the Species Plantarum, under the name Annona *reticulata*, joined the plant of Rumphius with the West Indian plant already mentioned; and if they be different, which I think probable, I cannot say which he really meant. He took no notice of

the Anona of the Hortus Malabaricus, deterred probably by the figure of the fruit, which is not *reticulata*, but *imbricata*.

In the Encyclopedie, the plant of Catesby alone was joined with that of Rumphius, and annexed to the Anona *reticulata* of Jacquin, to form the Anona *reticulata* α, while the plant of Sloane, notwithstanding the difference in the colour of the fruit, was joined with the Anona of the Hortus Malabaricus, to form the Anona *reticulata* β; and an observation is made, that the latter seems nearly allied to the Anona *asiatica*. So far the author is certainly right, that the Anona of Rumphius has an undoubted claim to be preferred to the name *reticulata*, having been mentioned as such by Linnæus.

Soon afterwards Willdenow divided, in a similar manner, the Anona *reticulata* into two varieties; but, according to him, the first is the plant of Jacquin, united with that of Sloane, Catesby, and Ray, with that of the Hortus Malabaricus, and with a new synonymon from Plumier, Guanabanus *fructu aureo et molliter aculeato*, which, even from this short character, seems different from either the plant of Rheede or that of Rumphius. The second variety joins the Anona of Rumphius with the Anona *mucosa* of Jacquin (considered in the Encyclopedie as the Anona *glabra*), and excludes all other synonyma.

In the Hortus Kewensis (iii. 334), the Anona of the Hortus Malabaricus alone is quoted for the Anona *reticulata*, and no notice is taken of the Anona of Rumphius. Amidst such confusion I do not wonder at neither being quoted in the Hortus Bengalensis; but the plant which is there (p. 23) called Anona *reticulata*, is that which I have considered as the Anona of Rumphius, although I must admit, that our plant agrees much better with the description of Rumphius than with his figure; for I have never

seen its fruit reticulated in any manner like what this represents.

I may venture to say, that there are only two species of Anona in any manner common in the gardens of India. The one is the plant which will be next mentioned, about which there is no difficulty. The other is the Nona of the Gangetic provinces, called Anona *reticulata* by Dr Roxburgh, which entirely agrees with the description of Rumphius; and, notwithstanding the figure of the fruit in this author has no resemblance to that of our plant, I think he meant no other; and I strongly suspect, notwithstanding the differences both in the figure and description given in the Hortus Malabaricus, that the same plant is there meant, and that Rumphius was right in considering his Anona and that of Rheede as the same. I am also inclined to think that this is indigenous, and that we have no American Anona common in India, except the *squamosa*. I am not, however, by any means clear that Burman was right in considering the Indian Anona as the same with the Anona *asiatica* of Linnæus. I never heard of its root being used as a dye; and, on this account, I have some suspicion that the Ahughas (Lin. Fl. Zeyl. 225), or Anona *asiatica*, is a Morinda. In the forests, however, bounding Bengal on the east, there has been found another indigenous species of Anona, named *Suriffa* by Dr Roxburgh (Hort. Beng. 43), which may be the Anona *asiatica*, although I suppose it to be rather the Khi of Rumphius, to be immediately mentioned.

Anona mas, p. 137.

Perhaps our Anona?

Fructus chinensis Khi dicta, p. 137.

This is perhaps the Anona *fructu rubicundissimo* of Linnæus (Fl. Zeyl. 509) and Burman (Thes. Zeyl. 21), excluding all the synonyma of American plants. It may, however, more likely be the Anona *sariffa* of Dr Roxburgh, the plants of Southern China having a great affinity with those from the north-east of Bengal.

Caput XL.

Anona tuberosa, p. 138, t. 46.

There can be no doubt that this and the Ata *Maram* of the Hortus Malabaricus (iii. 21, t. 29) are the same, and that they are the Anona *squamosa* of Linnæus, and subsequent authors. Notwithstanding what Plukenet says (Alm. 32), this is what the English abroad call Custard-apple; nor either in the East or West Indies did I ever hear it called Sweet Sop, as the Hortus Kewensis alleges (iii. 334) on the authority of Plukenet (Alm. 32). It is indeed impossible that any person could compare the fruit of our other species of Anona to a custard, or any thing tolerable. The Sweet Sop, in Jamaica at least, I believe to be the Anona *muricata*, called Cachiman in the French Islands.

Caput XLI.

Cujavus domestica, p. 140, t. 47.

Caput XLII.

Cujavus agrestis, p. 142, t. 48.

Since the time of Linnæus, the former of these has been called Psidium *pyriferum*, and the latter P. *pomiferum*; and Willdenow has placed no less than four species between them: but there is no real difference of species, in

the sense usually adopted by botanists, the two plants differing much less than many kinds of Apple (Pyrus *malus*). Dr Roxburgh (Hort. Beng. 37) did not distinguish them by the form, but by the colour of the fruit, calling those Psidium *pyriferum* which have a white fruit, and those P. *pomiferum* which have a red fruit. This, however, does not appear to have been the distinction of Rumphius, who considered the kinds that are acid, and approach the crab or unimproved plant, as the Cujavus *agrestis;* and the kind with a sweet fruit, much improved by cultivation, as the Cujavus *domestica.* There are a great many varieties, of both colours and forms, that have an excellent flavour, and must be considered as belonging to the latter. In India, although an exotic, the Cujavus *agrestis*, like the Pyrus *malus* in Scotland, has become a perfect forest or wood tree, the seeds having been scattered by birds, as they powerfully resist the organs of digestion.

Cujavus silvestris, p. 144.

Probably a variety of the Cujavus *agrestis.*

Caput XLIII.

Cujavillus, p. 145, t. 49.

Burman, in his Flora Indica (114), called this Psidium *cujavillus;* but it was unnoticed by Linnæus. The Compilers of the Encyclopedie received from M. Sonnerat specimens of a plant, which they called Psidium *angustifolium*, as synonymous for which they quoted the *cujavillus*, with, however, some doubt. Vahl, as usual, changed the name of Burman into Psidium *pumilum*, quoting, without hesitation, the *cujavillus* for the plant he meant. Willdenow prefers the name of Vahl to both that of Burman and that

of the Encyclopedie, and quotes both without any doubt of the plants they describe being the same; yet I suspect that the plant of Rumphius is not different from the Psidium *decaspermum* of Willdenow (Sp. Pl. ii. 958), which Forster considered as a distinct genus, in which he is supported by Gærtner, the former calling it Decaspermum *fruticosum* (Gen. Nov. N. 37), and the latter Nelitris *jambosella* (De Sem. i. 135, t. 27, f. 5).

Caput XLIV.

Papaja Mas et Femina, p. 145, t. 50, 51.

Ever since the time of Linnæus this plant has been called Carica *papaya;* nor does any commentary seem to be required.

Papaja silvestris, p. 149, t. 53, f. 1.

This is quoted by Willdenow (Sp. Pl. ii. 549) as the Bergera *Koenigii;* but I agree with the Compiler of the Encyclopedie (Sup. i. 620) in thinking them very different plants. From the description of the fruit in Rumphius, "post flosculos sequuntur fructus, qui pallidæ et rotundæ sunt baccæ, minores granis Oryzæ, superius planæ, ibique formantes coronulam ex quinque filamentis reflexis compositam, ac ipsis baccis plane incumbentibus, in qua albicans siccaque locatur medulla in quinque loculos divisa," I infer, that the fruit is "bacca pentasperma, calyce pentaphyllo coronata;" which, together with its habit, persuades me that the plant belongs to the order of the Araliæ.

Papaja litorea, p. 150, t. 52.

This also seems evidently to me to be a plant of the order of Araliæ, and M. Poiret (Enc. Meth. v. i.) considers it as a species of Panax; but this seems doubtful, as no-

thing is said in Rumphius, the only authority, to enable us to determine its genus.

Papaja Atehu, p. 150, t. 53, f. 2.

This also is evidently one of the Araliæ; and, if it has really eight petals, as Rumphius says, it is probably a Gastonia; but it is possible that his "octo petala" may include the divisions of the calyx, as well as those of the corolla.

Caput XLV.

Lansium domesticum album et rubrum, p. 151, t. 54.

Mr Correa, according to the Encyclopedie (Sup. iii. 299), considers this as nearly allied to the Cookia, in which I entirely coincide. It differs from the Cookia in having the seeds covered by a succulent arillus. It seems also to have a considerable affinity with Nyalel of the Hortus Malabaricus (iv. 37, t. 16); which, however, has its flower divided into five, and only two seeds in each berry. The two kinds mentioned by Rumphius seem such varieties as occur in all cultivated plants.

Caput XLVI.

Lansium silvestre primum et secundum, p. 153, t. 55.

Rumphius gives no mark, except the colour of the wood, by which these trees could be distinguished, and this will scarcely be accepted by botanists: nor does he mention to which his figure belongs.

Lansium montanum, p. 154, t. 56.

No reference is made to this plant by any author that I know.

Caput XLVII.

Cussambium, p. 154, t. 57.

In the observation annexed to this chapter, Burman compares the Cussambium to the Pongam of the Hortus Malabaricus (iv. 73, t. 35). The Compilers of the Encyclopedie (ii. 235) admit a certain resemblance, but point out the remarkable difference in the structure of their fruits. I must say that I see no resemblance; for the leaves of the Pongam are simple, and those of the Cussambium are pinnated: the former probably belongs to the Urticæ, and the latter to the Terebintaceæ. I have found the name Kusam very widely diffused in India, and applied in Kankana in the southern peninsula, and in Magadha on the Ganges, to trees like the Cussambium, having a very hard heavy timber, alternate abruptly pinnated leaves, small flowers disposed in racemes, and a drupa containing one nut. This genus approaches to the Schinus, but the structure of the drupa is very different, the nut almost entirely resembling the Koon of Gærtner (De Sem. ii. 486), which he takes to be an Ochna; but, as he never saw the nuts united, we may suspect a mistake. Besides the plant of Rumphius, which I have not seen, I have observed two species of this genus, and I thus distinguish the three:

1. *Cussambiam spinosum* drupis spinulosis, Herb. Amb. i. 157, e Rumphii Actuario.
   Cussambium, Herb. Amb. i. 154, t. 57.
   Habitat in India aquosa.

2. *Cussambium glabrum*, drupis inermibus, foliis glabris Linkeng, Herb. Amb. i. 157. ?
   Kusam Hindice.
   Habitat in sylvis Magadhæ.

Arbor elata ligno duro, utili. Ramuli nudi, cicatricibus obcordatis obtusangulis exasperati. Folia alterna, decidua, abrupte

pinnata; foliola sæpius trijuga, opposita, sessilia, oblonga, obtusiuscula, nuda, integerrima, costata, venis minute reticulata, latere anteriore basin versus angustato obliqua, superioribus longioribus. Petiolus basi incrassatus, brevis, nudus, teretiusculus. Rachis teretiusculus, nudus, non mucronatus. Stipulæ nullæ.

Flores dioici. In masculina racemi axillares vel infrafoliacei, folio breviores, erecti, pedunculati, aliquando ramosi rachi pubescente angulato. Pedicelli 3—4-flori, brevissimi. Flores virides, parvi.

Calyx quinque-partitus, minimus, fundo tectus disco carnoso maximo. Filamenta 7 vel 8 pilosa, disco inserta, calyce multoties longiora. Antheræ magnæ, oblongæ, quadrisulcæ. Germen nullum. Styli rudimentum in floris centro.

Fœmininam arborem florentem non vidi.

Drupa rudis, inermis, magnitudine Cerasi utrinque acuta, cortice crasso fungoso. Arillus duplex: exterior membranaceus, tenuis; interior succulentus, edulis, crassus, e basi seminis enatus, semen totum tegens, apice lacerus. Nux basi derasa, lævis, obovata, compressa, monosperma. Integumentum membranaceum. Semen incurvum, teretiusculum, septum dimidiatum e basi testæ enatum amplectens. Albumen nullum. Embryon incurvum: radicula infera; cotyledones magnæ semiteretes, exteriore crassiore.

3. *Cussambium pubescens* drupis inermibus, foliis pilosis, Koon Gært. De Sem. ii. 486. ?

Shaguda, Kiandalay, vel Shandalay Carnatæ.
Kussum Cancanæ.
Habitat in Indiæ australis sylvis.

Arbor mediocris ligno duro. Ramuli obtusanguli, pubescentes. Folia decidua, alterna, abrupte pinnata. Foliola opposita, 2 vel 3-juga, oblonga, sessilia, integerrima, costata, venosa, pilosa, ima brevia, subovata, obtusa cum acumine brevi; superiora elongata, latere inferiore longiore latiore obliqua, retusa cum acumine. Petiolus basi incrassatus, obsolete trigonus, pilosus, estipulaceus, mediocris. Rachis utrinque sulcatus.

Flores parvi virides dioici.

Hermaphroditæ arboris paniculæ infrafoliaceæ, longitudine foliorum decompositæ, pedicellis fasciculatis. Florum fasciculi squamula suffulti.

Calyx quinque-partitus, minimus, fundo tectus disco carnoso maximo. Filamenta 6—10, sæpius 8, pilosa, disco inserta. Antheræ bilobæ, nescio an fertiles? Germen superum, subpedicellatum, longitudine staminum. Stylus subulatus. Stigmata duo vel tria, crassa, pubescentia, revoluta.

Maris paniculæ folio breviores, compositæ e racemulis brevissimis 4—6-floris. Pedunculus angulatus, pilosus.

Calyx ut in hermaphrodita. Filamenta 7—8, pilosa, subulata, patentia, calyce multo longiora. Antheræ magnæ, oblongæ, quadrisulcæ. Germen nullum. Styli rudimentum simplex in disci medio.

Linkeng, p. 157.

This seems evidently to be a Cussambium, very nearly allied to my C. *glabrum*, above described, if it be really different; but being cultivated, its fruit is probably more succulent than that which grows wild in India, although this also is esculent.

Caput XLVIII.

Pomum draconum domesticum, p. 157, t. 58.

This seems pretty clearly to be a Spondias, but it is not mentioned by any recent author, so far as I know.

Caput XLIX.

Pomum draconum silvestre, p. 159, t. 59.

This also seems to be a Spondias.

Rau Genrang, p. 159.

Seems to be still another Spondias.

Caput L.

Condondum, p. 161, t. 60.

In a commentary on the First Part of the Hortus Malabaricus, I have explained several errors that have arisen

from that of Rumphius in confounding the Condondum with the Ambalam, and from the erroneous synonyma given in the observation of Burman. While the Ambalam is clearly a Spondias, I have little doubt of the Condondum being the Mangifera *pinnata* of the younger Linnæus, of which I have presented a specimen to the Company's collection.

Caput LI.

Condondum Malaccense, p. 162, t. 61.

Whether or not this be the same with the *Cat ambolam* of the Hortus Malabaricus (i. 93), as Burman in his observation asserts, I cannot say, as the account of the *Cat ambolam* is remarkably imperfect; but the plant here described by Rumphius seems clearly to belong to the same genus with the Mangifera *pinnata*, quite different from a Spondias; nor can I perceive any thing, except the leaves, to distinguish the Condondum from the Mangifera *indica*.

Caput LII.

Cynomorium, p. 163, t. 62.

This was called Cynometra by Linnæus, and subsequent authors have adopted the same name, although not a little objectionable.

Caput LIII.

Cynomorium silvestre, p. 167, t. 63.

Linnæus, following the observation of Burman, joined this with the Iripa of the Hortus Malabaricus (iv. 65, t. 31), to form the Cynometra *ramiflora;* and as usual has been followed, without comment, by more recent writers. I am very doubtful, however, concerning the identity of

these plants; for the leaves are described by Rumphius as very acute, "folia longiora, magisque acuminata;" while those of the Iripa are blunt, "oblongo-rotunda;" and, in the figure, appear as if even retuse. In Ava I found a tree called Mræn-ga, which agreed with the specific character of the Cynometra *ramiflora*, as given by Linnæus; but I did not compare it with the figures and descriptions of the two great Indian botanists. Specimens, however, were transmitted to Sir Joseph Banks, and may serve to throw more light on the subject.

Caput LIV.

Sandoricum domesticum, p. 167, t. 64.

The Compiler of the Encyclopedie (iii. 69), copied by Willdenow (Sp. Pl. ii. 556), quoted this, with doubt, as being the same with the Hantol of Camelli and Ray, which the French botanist called Sandoricum *indicum;* but it must be observed, that the figure of Rumphius represents the flower without any thing like the cylindrical nectarium, which in the Hantol supports the antheræ. No great stress can, however, be laid on this circumstance.

Sandoricum silvestre, p. 168.

Whether this is a distinct species from the preceding, or whether it is merely the plant in an uncultivated state, I cannot take upon myself to determine, although I think that I have seen the plant in Pegu; but unfortunately, like the specimen of the Sandoricum *indicum*, which the French botanist procured, the trees which I found were in fruit. In the language of Ava it is called Sit-to, and specimens were sent to Sir Joseph Banks. At the time I considered it as nearly allied to the Cratæva *tapia*, which, with

Dr Roxburgh, I then called a Capparis. The following note I took on the spot.

Arbor ramis teretibus, pubescentibus, fuscis, elevato-punctatis, sulco e petiolorum basi decurrente utrinque exaratis. Folia maxima, alterna, petiolata, ternata; foliola petiolata, integra, integerrima, supra nitida, subtus tomentosa, venis reticulata, plana; lateralia oblonga, acuminata, ad basin posterius gibbosiora; terminale latius, obtusum. Petiolus communis mediocris, basin versus incrassatus, apicem versus semiteres, pubescens: partialium laterales brevissimi; terminalis mediocris, teres, utrinque incrassatus. Stipulæ nullæ.

Pedunculus fructiferus axillaris, solitarius, fructu terminali indivisus, rudimentis quasi flosculorum abortivorum plurium lateralium notatus. Bacca supera, calyce deciduo nudata, globosa, striata, corticosa, unilocularis. Nuciculæ quinque pulpo filamentoso arillatæ.

From this it would seem that it differs from the description of Willdenow, in having the flowers disposed in undivided racemes, or perhaps spikes, while his plant has panicles.

Cajim-gulur, p. 168.

This may be another Sandoricum.

Caput LV.

Gajanus, p. 170, t. 65.

By Thunberg and Willdenow (Sp. Pl. ii. 604) this was considered as the Inocarpus *edulis* of the younger Linnæus; but the Compiler of the Encyclopedie (ii. 576, and iii. 253), on account of the form of the fruit, as represented by Rumphius, doubted of the accuracy of this quotation, and considered the tree as related to the Aleurites, or Euphorbiæ. On farther consideration, however, it would seem that the Compiler was satisfied of the quotation having been proper, as he repeats it in the Supplement (iii. 151).

I must notwithstanding say, that the figure of Rumphius has little or no resemblance to that of the Inocarpus *edulis* given by Gærtner (De Sem. iii. 114, t. 199, 200), and still less to that given in the Encyclopedie (Ill. Gen. t. 362). I suspect therefore some mistake, and this perhaps in the figure of Rumphius, which in some respects does not agree with his description; for he says of the fruit, "forma lunæ crescentis," which agrees somewhat with that of Gærtner, but by no means with that in the Herbarium Amboinense. Burman in his observation seems totally wrong in comparing either description or drawing to the Tani of the Hortus Malabaricus (iv. t. 10), which is no doubt a Terminalia, or Myrobalanus.

Caput LVI.

Atunus, p. 171, t. 66.

The Compiler of the Encyclopedie (i. 329), in mentioning this tree, does not venture to point out its place in the system. If it belong to the same genus with the Atunus *litorea* (iii. 95), I suspect that it may be a Niota, as I shall endeavour to point out on a future occasion.

Atun Puti, p. 172.

This has pinnated leaves, while the preceding tree has them simple. They probably therefore belong to different genera.

Caput LVII.

Vidoricum domesticum, p. 173.

Vidoricum silvestre primum, p. 173, t. 67.

These trees probably belong to the same genus; and if Gærtner (De Sem. ii. 105) is right in considering the Vi-

doricum *sylvestre secundum* (Herb. Amb. iii. 184) as a Bassia, these also may belong to the same genus, although they also strongly resemble the genus Diospyros; but to this subject I shall again have occasion to return. I need scarcely mention that Burman, in his observation on this plant, is totally wrong in considering it as of the same genus with the Caniram of Rheede (Hort. Mal. i. 67, t. 37), which is the Strychnos *nux vomica*.

Caput LVIII.

Catappa domestica, p. 174, t. 68.

Why Linnæus chose to give the name Terminalia to the genus to which this tree belongs, Rumphius having previously applied it to a totally different plant; and why, still farther, he did not give even the specific name *catappa* to the same tree that Rumphius called so, κατ' ἐξοχήν, I cannot say; but this is not the Terminalia *catappa*, nor does Linnæus seem ever to have seen it. M. Lamarck (Enc. Meth. i. 349) seems first to have introduced it into the modern system of botany, under the name of Terminalia *moluccana*, a name properly retained by Willdenow (Sp. Pl. iv. 968), although Forster had called it Terminalia *glabrata*; and Dr Roxburgh, probably in a private communication to Willdenow, had given it the name of Terminalia *glandulosa*. My worthy friend, however, before his death, adopted the name of Lamarck (Hort. Beng. 33).

Catappa litorea, p. 175.

Seems also no doubt to be a Terminalia.

Catappa silvestris, p. 175.

This, I have little doubt, is the Terminalia *catappa* of botanists, the Ada *maram* of Rheede (Hort. Mal. iv. 5),

because Rumphius states as follows:—" Oræ foliorum angustatæ fere ad petiolorum ortum, qui obducti quoque sunt tenui, rufa, et molli lanugine, quali itidem ramuli virides surculique obteguntur." The kernel, however, in the plant of Malabar, probably from cultivation, is superior in size to what it would appear to be in the wild plant of the eastern islands, fully equalling what Rumphius describes that of the Catappa *domestica* to be. The leaves, so far as I have observed, are quite entire, so that the only difference between the plants of Malabar and Molucca arises from the leaves of the former being hairy beneath, while in the latter they are smooth. The resemblance to this fruit mentioned by Plukenet (Mant. 156, cum Alm. 306 collata) appears to me far-fetched, and, notwithstanding the author's prudery, could only have arisen from a prurient imagination.

Caput LIX.

Cassuvium, p. 177, t. 69.

This plant, originally a native of America, has now spread itself, through most warm countries, in sandy places near the sea; but, in India at least, is seldom found in other situations. Its original name, Acajou, variously written and corrupted, seems to have followed the tree everywhere, and is known in Old India, the Eastern Archipelago, and China. The name Kapa Mava, given to it in the Hortus Malabaricus (iii. 65, t. 54), I never heard among the natives of Malabar, and suspect some mistake in Rheede.

Caspar Bauhin considered this tree as of the same genus with the Anacardium of the East, and therefore most properly called it Anacardii *alia species*. Linnæus, who knew no other kind, in imitation of Bauhin, called the West Indian plant Anacardium *occidentale*; but his son, having

obtained the original Anacardium of the East, and, finding some slight difference in the number of the sexual parts, made it a distinct genus; while, in place of reserving for this the name Anacardium given to it by the earliest botanical writers, he called it Semecarpus. Although this nomenclature is adhered to by Willdenow (Sp. Pl. i. 1476, et ii. 486), and many other most eminent botanists; yet, if the plants are to be considered as belonging to different genera, I must prefer the nomenclature adopted by Lamarck, followed by Jussieu and other French writers, who have restored the name of Rumphius to the Anacardii *alia species* of Bauhin, and the name Anacardium to the plant originally so called. As, however, I consider that both plants belong in fact to the same genus, I would call the former Anacardium *cassuvium*, and the latter Anacardium *semecarpus*.

Caput LX.

Cassuvium silvestre, p. 179, t. 70.

Willdenow does not quote this plant; but in the Encyclopedie (i. 140) it is considered as a variety of the Anacardium *longifolium*, which Willdenow calls Semecarpus *anacardium* (Sp. Pl. ii. 1476). Dr Roxburgh, on the contrary (Hort. Beng. 22), having procured plants from the Moluccas, considered it as a distinct species, which he called Semecarpus *cassuvium*; nor, indeed, did Rumphius suppose that his plant was the Anacardium of the shops, the nuts differing very considerably, in shape at least, being reniform in the Cassuvium *silvestre*, while in the Anacardium *orientale* they are ovate, with a slight notch, on one side, under the point, which is oblique.

In India there is still another species very nearly allied to the Anacardium *orientale*, and in fact confounded with it by the natives under the common name Bhela of the

Caput LXIII.

Morunga mas, p. 184, t. 74.
Morunga femina, p. 184, t. 75.

Some confusion here exists in the account of Rumphius; for he says, " Flores maris omnes pereunt, nec fructus relinquunt; feminæ autem flores excrescunt in ingentem siliquam;" from which we ought to infer, that the tree is dioicious: but in the plates both male and female are represented as producing fruit; and besides, from their leaves, the plants so called would appear to be different species, although in the description no notice is taken of this difference.

The older botanists noticed only one kind of Morunga, as is especially the case with Rheede (Hort. Mal. vi. 19, t. 11). Several of these authors noticed the resemblance of this plant to the Balanus *myrepsica*, or Nux Been of the druggists, although in general they mentioned an essential difference in its having winged seeds. Plukenet (Alm. 253) commenced a system of error respecting this plant, by considering it as the same with the Lignum *nephriticum* of America, an opinion which the Compiler of the Encyclopedie (Sup. i. 659) properly rejects; for the wood of the Morunga gives no blue colour to water in which it is infused.

The elder Burman endeavoured to establish two species of Morunga; the Morunga *mas* of Rumphius he called Moringa Zeylanica, pinnis rarioribus, flore minore (Thes. Zeyl. 164), distinguished by having only five stamina: while the Morunga *femina* of Rumphius he called Moringa Zeylanica, flore majore, fructu anguloso (Thes. Zeyl. 162, t. 75), distinguished by ten stamina. The character derived from the number of stamina, could we depend on the accuracy of Burman, would be excellent; but in the plant

so common about the villages of India, although there are ten filaments, five only of them have antheræ, as described by Rheede, "colus in decem staminula e viridi albula extrorsum flexa, divisus, quorum paria (*singula intellige*) uno grandiusculo flavescente obtegunturr apice:" and it is possible that Burman may have thought that some of the antheræ had fallen by accident from his specimen, and that in their natural state all the filaments were fertile. I have, however, seen two kinds of this tree, one growing near villages, and the other in woods, and answering to the Wattu (hortensis) Murungu, and Katu (sylvestris) Murungha of the Ceylonese; and, as I have not seen the flowers of the kind growing spontaneously in woods, it may have only five filaments, as Burman describes. I shall, however, again return to this distinction.

Linnæus, in the Flora Zeylonica (1755), not only adopted the error of Plukenet, in considering the Moringa as the same with the Lignum *nephriticum*; but still farther, he considered it, not only as belonging to the same genus with the Balanus *myrepsica* or Nux *behen*, but as being the same plant, an error from which Plukenet escaped. How Linnæus came to place the Moringa in the same genus with the Bondue of preceding authors, I cannot say; as, in my opinion, notwithstanding his eminent authority joined to that of Jussieu, I must agree with Gærtner in thinking that it cannot belong even to the same natural order (Leguminosæ), but seems to approach nearer to the Rutaceæ; although even this arrangement is not satisfactory, and it seems to belong to a genus rejecting a close affinity with all others.

The error of Linnæus, in joining the Moringa with the Bonducs, to form the new genus Guilandina, having become evident, Jussieu and other French botanists have most properly restored the name Moringa given by John

Bauhin. Neither this, however, nor the still more simple Anoma of Loureiro, has satisfied the modern taste for sesquipedalian Greek, from which Vahl and others have given us Hyperanthera,—a term applied by Forskal to a genus, which I suppose is very different, being really one of the Leguminosæ, with a calyx of one leaf, and a fruit consisting of two valves, to one edge of which the seeds are annexed; while in the Moringa there are three valves, supporting the seeds by their middle. Excluding the two species, which properly belong to the Hyperanthera of Forskal, or to the Gymnocladus of Lamarck, we shall have in Willdenow, as well as in Rumphius and Burman, two species of Moringa. Loureiro has also two species, a Moringa and a Morunga; but the latter, although joined by the Compiler of the Encyclopedie (Sup. i. 391), and by Willdenow, with the Morunga of Rumphius, having opposite leaves, must be a totally different plant. The synonyma, indeed, annexed to the Hyperanthera *moringa* by Willdenow, belong to four, or perhaps rather to five, different plants; and those referred to the Moringa *oleifera* in the Encyclopedie (i. 398), refer to two or three; and I find it impossible to say which of these plants were really meant. Both authors include the two species of Rumphius, to which the Encyclopedie adds a plant of Egypt and Arabia, the Balanus *myrepsica*, or Glans *unguentarius* of old writers (the Moringa *aptera* of Gærtner, De Sem. ii. 315); and Willdenow still farther adds, the American Lignum *peregrinum aquam cæruleam reddens* of Bauhin, by severals called Lignum *nephriticum*, and the Anoma *morunga* of Cochinchina, described by Loureiro, and in the Encyclopedie (Sup. i. 391), as having opposite leaves.

Now, to return to the Morunga *mas* et *femina* of Rumphius; neither of which, I am persuaded, grows naturally in Egypt nor America, and which, if not distinct species,

as Burman supposed, are at least remarkable varieties. The only reason, I suppose, which Willdenow had for stating that this species belongs to the class Polygamia diœcia, consisting of two different kinds of hermaphrodite plants, was the confounding the two species of Rumphius together. With much more reason he would have referred the Morunga *femina* to his Hyperanthera *decandra*, which, he says, has ten fertile stamina, as Rumphius represents in his figure, and this is the very character by which Burman distinguished it from the Morunga *mas*. In the Supplement to the Encyclopedie this change has accordingly been made; but then the Anoma *moringa* cannot be the Guilandina *moringa* of Linnæus, which is not the Hyperanthera *decandra*, but the Hyperanthera *moringa*.

Like Rumphius and Burman, as has already been mentioned, I have found two kinds of this plant. Perhaps the differences between them arise from the one being cultivated, and the other remaining wild; but this remains to be ascertained: and I am not able to verify whether or not the wild kind be the Hyperanthera *decandra*, as I did not see the flowers. I am by no means satisfied that either is the Morunga *femina* of Rumphius; for I do not think that I have ever seen a species with leaves so regularly bipinnated. I shall, however, mention what I have observed concerning the two species or varieties which I have seen. I reject the specific name *pterygosperma*, given by Gærtner, because he includes both species of Rumphius, and it is impossible to say which he meant.

1. *Moringa domestica* floribus semidecandris, foliis bipinnatis, pinnulis imis aliquando ternatis, foliolis utrinque obtusis nudis, seminibus alatis.

Hyperanthera Morunga, Hort. Beng. 32.
Hyperanthera Moringa, Hort. Kew. iii. 32.

Morunga mas, Herb. Amb. i. 184, t. 74.?
Mourungu, Hort. Mal. vi. 19, t. 11.
Mitha (dulcis) Sojana Hindice.
Dan-sa-lun Barmanorum.
Colitur ubique ad Indiæ pagos.

Arbor mediocris ramis nudis fragilibus. Folia alterna, bipinnata, pinnularum imarum una vel altera ternata. Foliola oblonga, utrinque obtusa, petiolata, integerrima, subvenosa, nuda, terminali majore obovato. Rachis nudus, supra carinatus, articulatus, ad divisiones incrassatus. Glandulæ pedicellatæ, caducæ, ad singulas folii divisiones supra positæ. Loco stipularum tubercula duo, oblonga, obliqua.

Panicula axillaris, ramis alternis multifloris folio brevior. Bracteæ squamæformes, vagæ, in paniculæ ramos sparsæ. Flores albi, mediocres.

Calyx ultra medium quinquefidus laciniis linearibus, obtusis, coloratis, obliquis. Petala quinque forma et magnitudine laciniarum calycis, calyci inserta. Filamenta decem calyce breviora, declinata, subulata, basi pilosa, alternis longioribus antheriferis inæqualia. Germen pubescens, oblongum, superum. Stylus subulatus, declinatus. Stigma acutum.

Fructus omnino ut capsula Moringæ pterygospermæ a Gærtnero (De Sem. ii. 214) delineata est.

Although I have quoted Rumphius with doubt, because his figure represents the small leaves (foliola) as sharp-pointed, and the leaves as abruptly pinnated, yet every thing he says respecting the growth, cultivation, and uses of the plant, as usual, is excellent, and applicable to the plant I have described. I do not quote Linnæus, the younger Burman, Willdenow, nor the Encyclopedie, because several plants are included by each among the synonyma of the Guilandina *moringa*, or Hyperanthera *moringa*, or Moringa *oleifera*, and it is impossible for me to determine which they really meant. I do not quote either plant of the elder Burman, because his second plant (Thes. Zeyl. 164), which he considers as the same with the Moringa *mas*, is said to have a small flower, which would not appear to be the case with that of Rumphius; nor is it the

case with my plant. Farther, his first plant (Thes. Zeyl. 162) is said to have ten stamina, all of which in the figure are represented as provided with antheræ; and, besides, the figure is a very bad representation of the plant which I have described. I have, however, very little doubt of this being the Watu or garden Moringa of the Ceylonese, as in every part of India it is the plant most common about villages.

2. *Moringa sylvestris* foliis subtripinnatis, pubescentibus; seminibus alatis.

Katu Murungha Ceylonensium, Burm. Thes. Zeyl. 163?
Tita (amara) Sojana Hindice.
Habitat in Magadhæ sylvis, et rarius ad sæpes plantatur.

Rami, rachides, folia pilosa. Folia subtripinnata, id est pinnularum imæ quinato-pinnatæ, intermediæ ternatæ, superiores simplices. Flores non vidi. Fructus simillimi Moringæ domesticæ.

This tree I have seen nowhere, but near Patna and Mungher. Its fruit is too bitter to be eaten in curries, as that of the domesticated species is; and is used only as a medicine. Having very strong sensible qualities, it probably possesses considerable power on the human body; and was probably that used by the Dutch physicians in Ceylon (Burm. Thes. Zeyl. 164), although some parts of even the cultivated kind would seem to afford a valuable medicine.

Caput LXIV.

Turia, p. 188, t. 76.

In a Commentary on the Hortus Malabaricus (i. 93), when treating of the Agaty, I have mentioned the botanical history of this plant, which is the same. As Rumphius says, that the Malabar name is Abati, we may conclude that either Agaty or Abati is a typographical error. In the observation following this chapter, Burman is quite

wrong in considering this as the same with the Kedangu of the Hortus Malabaricus (vi. 49, t. 27), which has flowers not larger than those of the bean (Faba).

Turia rubra, p. 189.

This is probably a mere variety, such as usually takes place in plants that are much cultivated. At one time I thought that it might be the Æschynomene, or Coronilla *coccinea* (Willd. Sp. Pl. iii. 1146); but that being the *Tœri mera* of Rumphius, is a sufficiently distinct species, which I have never seen. I suspect that in reality Willdenow fell into a similar error, as he says, "simillima præcedenti (Coronillæ grandifloræ). Flores ejusdem magnitudinis sed rubri:" but Rumphius, treating of the *Tœri mera*, says, "e rachidis ala petiolus excrescit in binos sese dividens minores, quorum quisque ingentem gerit florem paulo minorem quam præcedentis, id est C. grandifloræ."

Turia striata, p. 189.

This is probably another variety of the same elegant tree, with variegated flowers, not very common in India.

Tœri mera, p. 190, f. 77.

In treating of the Turia *rubra*, I have noticed this plant, which, by Forskal and the younger Linnæus, was called Æschynomene *coccinea*. Burman in his annotation is totally wrong in considering this as the same with his Emerus *siliquis geminatis longissimis* (Thes. Zeyl. 93, t. 41), which, I have little doubt, is the same with the Kedangu of the Hortus Malabaricus, and has not scarlet flowers.

Caput LXV.

Olus album domesticum, p. 191, t. 78.

Burman (Obs. p. 192) seems quite right in considering this as the same with the *Bem mænja* of Rheede (Hort. Mal. v. 113, t. 57). The name Naravolo, which, according to this author, the Brahmans of Malabar give to this tree, I found to be the name given in Carnata to a species of Cordia, called *angustifolia* by Dr Roxburgh (Hort. Beng. 17); but the two plants seem to have no affinity. It is singular that neither of our two great Indian botanists saw either flower or fruit of this tree. The leaf seems to have some resemblance to the Acacias *folio conjugato pinnato*; but this is all the resemblance that I can trace; and the Compiler of the Encyclopedie, who mentions Rheede's account (Sup. i. 613), gives no conjecture concerning its affinities. Neither is Plukenet, who mentions the tree (Alm. 66), more explicit; and he quotes Ray, who also describes it as producing neither flower nor fruit: but this excellent botanist, in calling the leaves *alata*, supports the opinion of its being an Acacia; although what I shall observe on the following plant seems to contradict this opinion beyond a doubt.

Caput LXVI.

Olus album insulare, p. 193, t. 79, f. 1.

The leaf of this has still more resemblance to that of an Acacia than that of the preceding plant, there being evidently a large gland on the common petiolus; but the description of the flower and fruit seems irreconcileable with this opinion, and the description of Rumphius would seem to imply, in the Linnæan phraseology, "calyx superus, quinquifidus. Petala alba. Stamina octo vel decem. Drupa sicca, ovata, pilosa, venosa."

Utta Pela seu Sajor Bagnala, p. 194, t. 79, f. 2.

Linnæus confounded this with two American plants of the same genus, which Plumier called Plukenetia. These were finally separated by Smith, and the plant of Rumphius is now called Plukenetia *corniculata* (Willd. Sp. Pl. iv. 515; Enc. Meth. Sup. v. 20).

Caput LXVII.

Eriophoros Javana, p. 195, t. 80.

Pliny mentions two different plants that contain in their fruit a wool fit for clothing. The one (lib. xii, cap. 10, 11) he calls Arbor *gossampinus*, the other he calls (lib. xix, cap. 1) Frutex *gossipion*, forming thus two natural genera; and as botanists have usually written in Latin, they should have preserved the names thus judiciously given by their Roman precursor. I agree with Rumphius in thinking that the Arbores Gossampini include the Eriophoros *javanica* and several kindred species; while the Gossipion includes the plants now in more common use for producing cotton-wool.

The older botanists, such as C. Bauhin and Plukenet, considered all the plants producing cotton-wool as forming one genus, and preferred the name Gossipion; probably, however, judging themselves better Latinists than the Roman Consul, they changed this name into Gossypium, to which orthography their successors carefully adhere. Tournefort rejects the name altogether, and prefers Xylon, which indeed Pliny mentions as being a more common name than Gossipion, for the shrub bearing wool; and so far, therefore, the French botanist was entirely justifiable; and so might even the older botanists be held, who, considering all the wool-bearing trees as belonging to one genus, gave the classical name Gossypium to the whole.

Linnæus was, I believe, the first to renew the idea of Pliny, in dividing these plants into two genera: but in doing so, while he continued the term Gossypium for the Gossipion of the Roman, he bestowed Xylon, another term for the same plant, to Pliny's Gossampinus. This was in the earliest part of his course, when he published the Hortus Cliffortianus and Flora Zeylanica. Soon after he seems to have become sensible that the term Xylon was ill-applied to the Gossampinus of Pliny, and he therefore abandoned it in the first edition of the Species Plantarum; but, in place of restoring the name of Pliny, or adopting Eriophoros used by Rumphius, or Ceiba applied by Plumier to plants of the same genus, he used the word Bombax, of which I do not know the origin. It has, however, been adopted by all modern botanists, except Gærtner, who might perhaps have been justified in resuming the Gossampinus of Pliny; but the Bombax of Linnæus is surely as good as the Ceiba of Plumier. Perhaps the Bombax of Linnæus should be left to one of the species earliest described by him, the Bombax *gossypinum* or *conga*, which is quite different from the others, does not belong to the same natural order, but rather to the Tiliaceæ, and is not an Arbor *lanigera*. In this case, the classical name Gossampinus should be restored to the other species of Bombax, the authority of Gærtner being scarcely sufficient to introduce Ceiba.

Rumphius, and the elder Burman in his annexed observation, seem to have considered the Eriophoros *javanica* as being the same with the Pania or Paniala and Moul Elavou of the Hortus Malabaricus (iii. 59, t. 49, 50, 51, et 61, t. 52); but this is evidently a mistake, as the stamina of the Moul Elavou distinguish it clearly from the Eriophoros Javanica. The Pania was quoted by Plukenet (Alm. 172) as his "Gossipium seu Xylon arbor Orientale

digitatis foliis lævibus, fructu quinquecapsulari, aloa et nitente lanugine farcto;" but unless the figure (Phyt. t. 188, f. 4) be very bad, he must have been mistaken, as it represents numerous stamina; on which account, his plant is quoted by Willdenow for the Bombax *heptaphyllum*, although in other respects it has but little resemblance to that tree. The synonyma, however, which Plukenet gave, probably all belong to the Pania or Eriophorus Javanica, although he quotes the former erroneously, as if Pania Paniala had been one name, an error copied by several subsequent writers.

Linnæus, in the Hortus Cliffortianus and Flora Zeylanica, endeavoured to distinguish the species of this genus by the presence or absence of prickles on the stem; and indeed Rheede takes no notice of the prickles on the Pania, while he mentions these of the Moul Elavou, the very word Moul implying prickles. Linnæus, however, soon afterwards learned, that the stems of the younger trees of the Pania are prickly, as is stated by Rumphius; and he therefore had recourse to other distinguishing marks, without, however, altering the synonyma, which his former defective characters had induced him to adopt, in considering two American trees as the same with the two plants of Asia, because one had a smooth, and the other a prickly stem.

Caput LXVIII.

Bilacus Tellor, p. 167, t. 81.

Into the explanation of either this or the following plate some error has crept. The fruit represented at A is said to be that of the Bilacus *taurinus*, but this again is said to be represented in plate 82. The fruit marked B is said to be the Bilacus *ovalis* or *tellor*, and the fruit C is said

to be that of the Bilacus *minimus* or *Kitsiil;* but no such species is mentioned in the text: and the third kind described there is the Bilacus *Pissang*, which, as Rumphius says, " nomen obtinuit ab oblonga forma instar Musæ Pisangh dictæ;" but the fruit C is shaped like a pear, and cannot represent such a Bilacus, as is described. These three fruits, I think, represent three varieties in form of the Bilacus *tellor*, which may indeed be called *maximus*, *ovalis*, and *minimus;* but these are merely such varieties as occur in all cultivated plants; while the Bilacus *taurinus*, if it be represented in plate 82, and Bilacus *Pissang*, are probably distinct species. On this subject, however, I must, for a farther account, refer the reader to the Commentary on the Bilacus *taurinus*.

The Bilacus *tellor* and its varieties were early noticed by botanists under the name Marmelos, corrupted from the Marmeleira of the Portuguese, given to it because this people seem to have prepared a marmalade from its fruit; on which account the older botanists compared it to the Cydonia, a tree resembling it in no other respect. In the Hortus Malabaricus (iii. 57, t. 37) it was described under the name Covalam; but the commentator, Commeline, still adhered to the slight resemblance with the Cydonia. Plukenet seems to have been sensible of the absurdity in this comparison; but he was little more fortunate in calling it " Cucurbitifera trifolia, spinosa, Indica, fructus pulpa Cydonii æmula," (Alm. 125; Phyt. t. 170, f. 5). Now his Cucurbitiferas include Crescentia, Strychnos, and other plants equally dissimilar. The elder Burman (Thes. Zeyl. 84) continued to class it with the Cydonia, but gives the synonyma of preceding writers with sufficient accuracy. In the Flora Zeylonica, Linnæus was equally unfortunate with his predecessors, and united this plant with the Tapia of Margrave, which he supposed to be the Niirvala of the

Hortus Malabaricus (iii. 49, t. 42), to form a new genus, which he called Crateva, the Niirvala being scarcely distinct from a Capparis, while the Bilacus belongs to the tribe of Aurantiæ. Things respecting the Bilacus continued in this state, only the name Crateva was changed into Cratæva, and the Bilacus was called Bilanus (Willd. Sp. Pl. ii. 853), until Dr Roxburgh proposed that it should be called Correa; but, another plant having obtained this name, the Bilacus by Persoon was called Ægle *marmelos*, the appellation that it still retains.

In every part of India this tree is common. The natives of Ava call it Oush-shit; those on the banks of the Ganges, in the spoken dialects, call it Bel, corrupted from the Vilva of the sacred tongue: but as the fruit is dedicated to the god Siva, it is usually called Sriphula, or the Sacred fruit. In the Hortus Bengalensis it is stated, that a variety, with a small fruit, is the Sriphula; and I have often heard the natives distinguish the Sriphula from the Bel; but on requesting a Pandit, attached to my survey, to bring me the Sriphula, he brought me a fruit in shape and size exactly resembling that marked A in Rumphius. The fruit of this tree I shall here describe on the plan of Gærtner, and this, I believe, will be new to the European botanist.

Fructus obovatus, magnitudine ovi anserini, lævis, glanduloso-punctatus, odoratus, absque rudimento vel calycis vel stigmatis, apice subumbilicatus, parietibus lignosis crassis uniocularis, farctus pulpo subfarinaceo, fibris paucis intermixto, 10 seu 12 loculari. Loculi verticales, remoti. Semina in singulis loculis quina seu sena, uno super alterum posito, gelatino pauco pellucido tecta, ovalia, magnitudine pisi compressa, pilis longis involuta. Integumentum simplex, membranaceum, crassum, intus politum, ex embryone facile secedens. Perispermum nullum. Embryo forma seminis. Cotyledones crassæ, maximæ, albæ, hinc convexæ, inde planæ. Radicula parva inter cotyledonum margines nidulans, nunc ad extremitatem, tunc versus latera posita.

The kind called Bel by the Pandit was in flower, which was as follows:

Calyx planus, parvus, quadrilobus. Petala quatuor, calyce alterna, oblonga, obtusa, patentia, crassa, ungue lato disco calycino inserta. Filamenta plura, indefinita, ibidem inserta, brevia. Antheræ longitudine filamentorum lineares, quadrisulcæ, acutæ, longitudinaliter ad latera dehiscentes, biloculares. Germen pyramidale, tetragonum. Stylus brevis, teres. Stigma magnum, incrassatum, obtusum.

From this having only four divisions in the flower, if this mark were constant, the Bel may be a distinct species from the plant of Rheede (Hort. Mal. iii. 37), described by Dr Roxburgh, which has five divisions in the flower, and which, the Commentator on the Hortus Malabaricus justly says, is the Sriphula (Scrifole) of the Bengalese, as this also has five divisions in the flower; and the same seems to be the case with the Bilacus *tellor*, to judge from the figure.

The fructification of the variety of the Bilacus *tellor*, with the large globular fruit, I thus described in Ava:

Calyx inferus, persistens, planiusculus, quinque vel rarius quadrifidus laciniis ovatis. Petala quinque vel rarius quatuor æqualia, calyce multo longiora, revoluta, coriacea, oblonga, obtusa, sessilia, pellucido-punctata. Filamenta plura, ad basin quinquefariam approximata, hypogyna, subulata, patula, corolla triplo breviora. Antheræ patentes, lineares longitudine fere filamentorum. Germen receptaculo orbiculato insidens, ovatum, octo vel decem sulcis exaratum. Stylus brevissimus, crassus. Stigma clavatum, apice obliquum, umbilicatum. Bacca globosa, parietibus lignosis intus pulpo farcta. Semina plura ovata, plana, sparsa, nidulantia, pilosa.

From this it would appear, that, in this variety, the number of divisions in the flower is not fixed; and I am therefore led to consider, that a proper distinctive character cannot be founded on this circumstance.

Bilacus Madia Pissang, p. 199.

Whether this be a mere variety of the Ægle *marmelos*, or a different species, I cannot take upon myself to say. As I have already mentioned, the fruit C, in table 81, can scarcely have been meant to represent that of this plant, which has a fruit like that of the Musa, at least in external shape.

Caput LXIX.

Bilacus taurinus, p. 199, t. 82?

It seems strange that Rumphius should say, "flores ignoti mihi hactenus sunt," and that, notwithstanding this, they should be fully represented in the 82d plate, which in the explanation is called Bilacus *taurinus*. I am therefore inclined to think, that the plate may represent the following plant, the more especially as it has no thorns. In this case, the fruit A, table 81, as stated in the explanation of that figure, may, in fact, represent the Bilacus *taurinus*, which, on this supposition, would be a mere variety of the Ægle *marmelos*, and the most common form indeed, which this tree assumes in the Gangetic provinces; and, according to Rheede, it is the Slymappel of the Dutch, which is the Covalam of Malabar. It must, however, be confessed, that the interior structure of the fruit, as I have described it, agrees entirely with that of the Bilacus *tellor*, as given by Rumphius; but not at all with that of the Bilacus *taurinus*, which has only four or five seeds in each fruit, in which circumstance, also, it by no means agrees with table 82.

Bilacus Amboinensis silvestris, p. 200, t. 82?

For the reasons mentioned in the Commentary preceding, I suspect that this is the plant represented in table 82,

although the contrary is stated in the explanation of that plate. It seems, at any rate, to represent an Ægle different from the *marmelos*, and hitherto unnoticed in modern systems.

P. S. In enumerating the synonyms of the Eugenia *Jambolana*, it escaped my notice, that it is the Caryophyllus *aromaticus* β of Burman (Fl. Ind. 122).

Since writing the Commentary on the Lansium *domesticum*, Mr Jack has published an account of this tree (Lin. Trans. xiv. 115), to which I beg here to refer; only observing, that he classes it with the Meliæ, an order which requires much revision, as it depends on the flower alone.

XXI.—*On the Power possessed by the Spider of propelling its Threads, and on the Ascent of that Insect into the Atmosphere.*

By JOHN MURRAY, F. S. A. F. L. S. F. H. S. &c. &c.

(*Read 20th March* 1824.)

IF the business of the entomologist be confined to the collection of a portfolio of butterflies, or the technicalities of mere nomenclature, we may consent to the praise of diligence and labour, but cannot approve the soundness of his views as a naturalist. Confined within these unenviable limits, entomology is but dull and unprofitable.

I do hold, however, that the entomologist may reasonably assume higher vantage ground, and lay claim to nobler pursuits; and if the physiology of insects be taken into the estimate,—their curious structure and mechanism,—their habits,—their amusements,—their cares and sorrows, the study expands in interest and importance. In this last pleasing department, Messrs Kirby and Spence have high claims on our grateful respect.

After we have bewildered ourselves in computing the movements and revolutions of those wondrous orbs that

float in fearful sublimity in the boundless sky,—marvelled at their mighty structures, and wandered wearily from planet to sun, and from star to star, till we have been lost in the exceeding majesty of the scene, it is refreshing to the exhausted spirit to descend from the celestial excursion, and join the ranks of the botanist, or the entomologist, and to feel assured that the goodness of the DEITY has not been exhausted on those unmeasured worlds, but that his beneficence is extended to the lowest of his creatures.

Among the various phænomena presented to the research of the entomologist, there does not seem one more curious and interesting than the ascent of the wingless Spider into the atmosphere,—a fact unquestionable and unquestioned. It is one, however, recorded without a solitary attempt toward its solution. I have consulted authorities in vain, among others, Linnæus, Shaw, and Donovan.

The gossamer-web was formerly believed to be a tissue of "scorched dew;" hence Spenser—

> The fine net which oft we woven see
> Of scorched dew.

Even Dr Hooke said that the gossamer only "much resembled a cobweb," and believed that "the great white clouds that appear all the summer time might be of the same substance."

Swammerdam and De Geer ridiculed the idea of the flight of spiders.

Dr Hulse first observed the property which particular spiders possess, of propelling their threads into the air.

Dr Martin Lister discovered that spiders were wafted aloft on this airy vehicle; and in fine weather (in September) he found, more than once, a spider which, from its flight, he called "The Bird." Afterwards, he noticed that the insect, by elevating the anus, darted a thread from thence, and thus rose into the atmosphere.

From the highest point of the Cathedral of York, Dr Lister beheld the gossamer-webs floating far above him.

Mr White of Selborne confirms, by actual observation, Dr Lister's account. He noticed a spider dart off from the page he was then perusing, and, though the atmosphere was tranquil, it rapidly ascended.

It has been considered that this property is not peculiar to one species, but that several spiders, when young, can so elevate themselves.

Mr White conceived that spiders in their transit through the atmosphere could coil up their threads, and descend *ad libitum* from their aërial excursions, altering in this manner their specific gravity.

I am not aware that any have attempted to describe the gossamer-spider as a distinct and peculiar species, Bechstein and Starck excepted; but they seem to describe different species.

Thus the former describes it as being the size of a small pin's head, having eight eyes disposed in a circle; body of a dark-brown colour, and light-yellow legs.

Starck describes his one as extending more than two lines in length, eyes in the form of a square, two on each side, in contact with each other; thorax of a deep-brown colour, with paler streaks; the under side of the abdomen of a dull white, and a dark copper-brown colour above, having a dentated white spot running longitudinally down the middle.

Dr Starck imprisoned several of these under a bell-glass, on a grass-plat, and he tells us they existed two months without food, though they took water greedily.

Mr White observed a remarkable phænomenon on 21st September 1741. Early in the morning the whole country was enveloped in a coat of cobweb, wet with dew. His dogs (being on a shooting excursion) were blinded by them.

A delightful day succeeded. About 9 o'clock A. M. fell *a shower of these webs*, (not single threads, but formed of flakes), some nearly an inch broad, and 5 or 6 inches long; and such flakes continued to fall during the entire day. Baskets-full might be collected from the hedges; and from the velocity of their fall, it was evident that they were considerably heavier than the medium through which they descended.

The small spider with which these remarks are connected, has its eyes disposed in a *circle* somewhat elongated, the body and legs, examined with a lens, are hairy, palpi bifid, and protuberant at the end; tarsus forked or clawed; legs, &c. somewhat translucent; abdomen and thorax glossy, and of a dark ferruginous colour; anal processes 3; the femur and tibia have each two articulations.

Several of these spiders, included in a crow-quill, were transmitted to Professor Jameson. Those called "Money Spiders" by the reapers in some parts of England, I presume to be the same insect.

The Reverend Mr Kirby writes me, that he thinks the Aranea *obstetrix* of Starck is that now spoken of: but the one described by Starck under this name is *striped*, and the eyes are arranged in the form of a *square*, which are sufficient distinctions. The subject of this communication approximates more nearly to Bechstein's A. *obstetrix*.

I shall take leave to call it "Aranea *aëronautica*," because, under the name Aranea *obstetrix* the German naturalists describe *two different insects;* and I, moreover, believe Starck's A. *obstetrix* to be (perhaps) the *young* of the Aranea *geometrica*, met with in hedges. The chief reason, however, for my proposing the assigned name, is the fact I have discovered, that its ascent and movement in the atmosphere are *essential to its very existence.*

I know well that the Aranea *geometrica* does possess the power of propelling threads into the atmosphere, and of thus changing its locality or making its escape; and perhaps, too, the *young* of this insect may possess the power of taking an aërial excursion occasionally. Now, *if so*, I am persuaded it is a *very rare* event. The other is distinct and peculiar, and the numbers that occur in the atmosphere are such as sufficiently to account for the *gossamer*, and its beautiful and interesting phænomena. It cannot therefore be doubted, that those threads which glisten in the sun-beam, and float in the air from the hedges and hedge-rows, and the reticular tissue on grass, which, when sparkling with dew, refracts so beautifully the tints of the rainbow, are the work of the aëronautic spider.

As a proof that these wingless "birds" are more numerous than may be generally suspected, I may merely mention, that, in the month of July 1822, on the top of the coach from Kidderminster to Stourbridge (a distance of only nine miles), there fell on me, or near me, *thirteen* aëronautic spiders, all of which I caught, and imprisoned in chip-boxes, which I carried with me for that purpose. This species of spider may be frequently met with in *coach-offices*, having alighted on the passengers, or on their luggage.

Connected with this question, I may mention a curious phænomenon that I witnessed on the 16th September last year, at Bewdley, Worcestershire. Between the hours of 11 A. M. and 2 P. M. the whole atmosphere seemed to be a *tissue of cobwebs;* they continued to fall in great numbers, and in quick succession. The temperature was 72° Fahrenheit. Some of these were single, others branched filaments, occasionally seen to extend from 40 to 50 feet in length. Others were woolly films, or flocculi. Some fell slowly, and others more rapidly. This was first noticed in the market-place, at Bewdley; and, on repairing to the adjoining fields,

I found the same phænomenon, and my clothes were most curiously invested with a net-work of spiders' threads.

In a communication to the Reverend J. J. Freeman of Kidderminster, I remarked this circumstance; and the following is an extract from his letter to me, dated 18th September 1822:—"The fall of cobwebs was also observed here on Monday. A gentleman told me he was obliged to wipe his face several times while walking in his garden about 12 or 1 o'clock, such quantities continued to fall on him."

On the 19th of July 1822 (the anniversary of the Royal Coronation), the yeomanry, at 1 o'clock P. M. were drawn up in the market-place at Kidderminster, and fired a *feu-de-joie* on the occasion. This had the effect of bringing great numbers of the Aranea *aëronautica* from the aërial regions; very many I picked up from the pavement, when the yeomanry had withdrawn; and several took refuge on the table where I was engaged reading, near the window of the hotel, and which was then partly open.

I have stated that a free and unrestrained privilege of ascent into the atmosphere is a condition essential to the very being of these remarkable insects.

The Blaps *mortisaga*, it is known, will live *three years* shut up, and without food. I have kept the Aranea *diadema* two months under similar circumstances. An entomologist informed me he had kept a spider three months without food; and indeed this insect has been preserved alive *upwards of a year* confined, and wanting nutriment.

The Aranea *aëronautica*, however, I have invariably found, is impatient of confinement, and will *die*, whether imprisoned in a chip-box or glass-tube (shewing that *light* does not affect the question), sometimes in *twenty hours*, or at most in *two or three days*.

I introduced one of the aëronautic spiders under water;

but though it remained there upwards of a minute, it did not appear injured thereby; and when withdrawn, soon let itself fall from a point, by means of a thread.

Posited gently on water, at 66° Fahrenheit, it remained on its surface, without attempting to escape by the propulsion of a thread. It took repeated springs forward, and then receded, patting the water rapidly with its tarsus, in the manner of the squirrel.

In water at 67° Fahrenheit, it was quiescent. When reposing at the bottom of a tumbler of water, there issued from between the palpi an air-bell, which, expanding, carried the spider to the surface; the aërial appendage thus diminishing the specific gravity of the aggregate, and affording a striking elucidation of the habits of the Aranea *aquatica*.

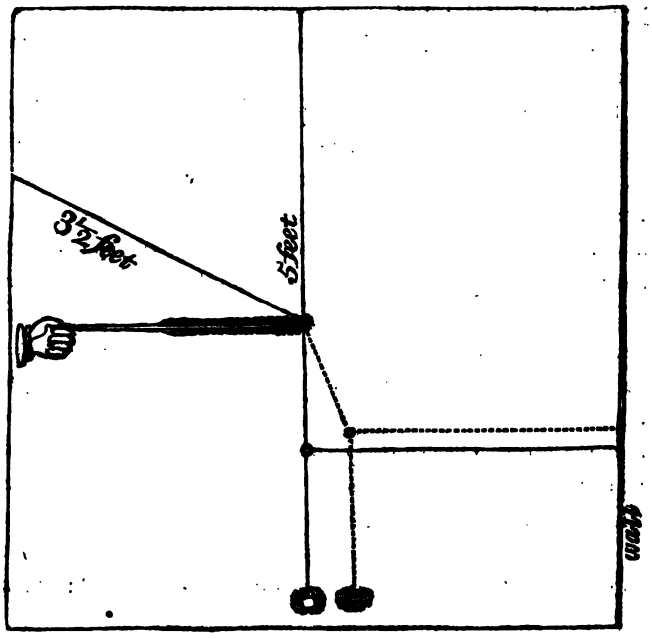
An aëronautic spider being put into water at 94° Fahrenheit, remained at the bottom of the vessel, sometimes at rest, sometimes locomotive. It projected a thread upward, and by that means, *sailor-like*, wound itself, resting at intervals, to the surface of the water. At the close of the experiment the temperature of the fluid had fallen to 86° F.

One of these spiders, by candle-light, darted instantaneously a thread to the ceiling of the room (eight feet high); it described an angle of about 80° with the horizon. By means of the combined act of the tibia and tarsus, "guiding them wittingly," the thread was made to spin with great rapidity on its axis; and during this period it moved gradually toward the vertical plane, and, being thus highly twisted, formed a stronger medium of escape.

During my stay at Chester, while I was experimenting with an aëronautic spider, during a warm day, and brilliant sunshine, about noon; when my room-door was a-jar, and the insect in the act of propelling its threads in all directions, it suddenly darted toward the door, in the direction

of the influx-current, a thread perfectly horizontal, and in length 10 feet. The angle of vision being particularly favourable, I observed *an extraordinary aura or atmosphere round the thread*, and which I cannot doubt was *electric*.

There are many phænomena that dispose us to believe the thread to be electrified. The following diagram will afford a representation of one of my experiments made in a room. The deflection from the vertical plane in the direction of the dotted diagonal line, is, I think, to be ascribed to the attraction obtaining between the wall as the conductor and the electrified thread. The aëronautic spider threw out two threads toward the ceiling, one perpendicular, and the other inclined; and then let itself fall from the end of a quill, resting at a woolly ball, and from thence projecting a horizontal thread, subsequently descending.



I first began my experiments and observations on this curious subject on the 2d of June 1822. One of these spiders alighted on me, and glanced off from my hand with considerable rapidity: thermometer 77° in the shade.

It is impossible to walk in the fields without being saluted by several of these insects; they will be chiefly noticed by alighting on the hat, and descending by a thread before the face: in this way they are easily caught, as they will drop into a chip-box, and may be secured. Received on a pencil, or the like, they will soon be perceived to oscillate like the pendulum; oftentimes rising from the perpendicular into the horizontal plane, at each ascent projecting a thread into the atmosphere; and, finally, by a twitch or jerk, the insect breaks from its anchorage, and ascends. It is difficult to determine whether the insect *bites off* the connecting thread, or breaks it off by main physical strength; but from the sudden twitch which appears to detach it, I am inclined to believe that the latter is the fact.

Sometimes the aëronautic spiders will take their flight immediately from the surface on which they alight, if the day be warm and sultry; but generally they descend to from 6 to 18 inches, perhaps the better to *insulate* them, and that, suspended by a pliant thread in free space, they may more freely propel their threads into the atmosphere.

Not unfrequently the propulsion of a solitary thread will bear them aloft, but the air must then be very warm, and its electric character be high. Sometimes the ascent is rapid, and cannot be followed by the eye; at other times it is slow and majestic. Occasionally the ascent is quite vertical, and at other times the animal sails on the bosom of the air, either in the horizontal plane, or at angles more or less acute.

It will be also found that there are *particular seasons* of the year best calculated for this singular exhibition: spring

and autumn are those periods. In summer I have frequently found it utterly impracticable to determine their ascent. When they detached themselves, after several vibrations, they have fallen to the ground like a dead weight. One day last summer (May) this remarkable fact was determined in the case of nearly a dozen which I picked up, —all that I experimented with on that day.

The insect would seem to be aware when the threads are sufficient for its ascent: perhaps the temporary suspension in the horizontal plane may communicate that information.

The aëronautic spiders make their appearance early in the season. One fell on me in the beginning of March last (1823), while I was perambulating the streets of Bath.

I have frequently shewn the phænomena of the aëronautic spider to my friends, and to Mr T. Hopkins of Kidderminster, and Mr T. Brown of Cirencester. To the latter, indeed, I one morning, in a very short period, pointed out the phænomena in five or six different instances.

Several circumstances concur to shew the phænomenon of ascent to be *electric*. The propelled threads *do not* interfere with each other; they are divellent, and this divergence seemed to proceed from their being imbued with similar electricity; and the *character* of that electricity appeared to me to be an interesting subject for subsequent research.

The aëronautic spider, brought near a candle, descends by its vertical thread, winds it up, and descends again very rapidly and repeatedly. The flame seemed not to attract a short upright thread, though the *finger* brought near, did. Placed nearer to the flame, the animal seemed incapable of descending farther, but moved circularly.

The point of a gold wire was brought near to the vertical thread, in one experiment, and above the spider in the act of escape to the ceiling of the room. It evidently dis-

concerted its progress, and the animal seemed agitated and unable to ascend. On removing the point the insect soon made its escape.

When the conducting wire is brought near to the thread by which it suspends itself, but, above all, to the flocculi or wool-balls, the thread is considerably deflected from the perpendicular, and the horizontal fibre is attracted by the point.

When a metallic conductor is brought near to the suspended spider, it disarranges its projectiles, and the insect, conscious of some counteracting agency, promptly coils up its threads.

When a stick of excited sealing-wax is brought near the thread of suspension, it is evidently *repelled;* consequently the electricity of the thread is of a *negative* character. The descent of the thread is instantly determined by bringing over it the excited sealing-wax; and if strongly excited, and the spider let fall on its surface, it bounds from it with considerable energy.

On the 3d of July 1822, at 4 P. M., thermometer 66° Fahrenheit, two aëronautic spiders, on separate threads, were brought near to each other; a mutual repulsion supervened; and when one was brought in momentary contact with the other, it immediately fell lower in the perpendicular plane.

An excited *glass*-tube brought near, seemed to *attract* the thread, and with it the aëronautic spider. When the insect was thus *positively* electrified, the rapidity which marked its descent, and extent of thread spun out, and which I frequently coiled up, was truly astonishing, being at least 30 feet in length.

In one experiment made, the ascent of the insect was so slow and tranquil, from the humidity of the lower atmosphere and wetness of the terrestrial surface, that I could

easily catch the insect by following its progress: it moved in a plane parallel to the point of departure.

On the 4th August 1822, at 3 P. M., thermometer 66°, the ascent was slow and beautiful, the little aëronaut rising regularly in the vertical plane. It was distinctly perceived from the steady fixation of the eye, and favourable angle of vision, until it had attained an elevation of 30 feet at least, and was finally lost in the vanishing point of elevation.

A variety of other phænomena unite their testimony in favour of the conclusions which I have formed, and from what I consider the direct method of induction.

Were the thread not electrical, I do not see how it should be propelled through the atmosphere in the vertical plane, and remain there, contrary to the laws of gravitation. It is indeed remarkable, that the threads should remain in the precise plane in which they are propelled, nor ever swerve from that path. The constant relative separation finds an analogy in similarly electrified pith-balls, or the divergence of the filaments in the case of a glass plume, &c., placed on the conductor of an excited electrical machine. The undulations of an agitated atmosphere disturb rather than favour the ascent of the little aëronaut. The electric or calorific state of the atmosphere will be found always to modify the phænomena. The transit of the thread through a resisting medium, without its suffering deflection in its path, proves it to be imbued with a power superior to, and able to combat with or overcome, that resistance *. The instantaneousness of the propulsion of the projectile

* The friction sustained in its sudden propulsion through the resisting atmosphere would alone be capable of investing it with electricity. I have seen, in the case of a fibre of very fine-spun glass suddenly drawn upward, that it continued *vertical*, and I found it *electrical*.

can find no reasonable cause but in the subtilty of electricity and excitation of that mighty power. An illustration somewhat connected with the question is found in the propulsion of fine threads from melted wax connected with the conductor of the electrical machine in action, the threads being received on the surface of paper.

When the superior regions of the atmosphere are charged with *positive* electricity, while the threads are imbued with *negative* electricity, ascent into the atmosphere becomes a *necessary consequence*.

It is difficult to ascertain what part this ascent into the atmosphere subserves in the economy of Nature. Whether the spider becomes food for other insects, remains a question; but I have, in *several instances*, found that, while it oscillated, some prowling *Vespa*, or wandering *Musca*, has snapt up and carried off my "Aranea *aëronautica*."

MACCLESFIELD,
October 31. 1823.

XXII.—*Observations on the Migrations, or occasional Migrations, of the Golden-crested Regulus, or Wren.*

By P. J. Selby, Esq. of Twizell-House, Belford, M. W. S. &c.

(*Read 20th March* 1824.)

In the course of my ornithological observations, I had for some years remarked, that the Golden-crested Regulus, or Wren, (Sylvia *Regulus* of Latham and Temminck), at a particular period of the year, suddenly became more numerous and abundant than I could account for, from the quantity annually produced in my immediate neighbourhood. The time I allude to has usually been towards the close of October, or beginning of November. At first, I thought the influx might come from the northern parts of Scotland, and probably consisted of the young of the year, which at that season were impelled to seek a warmer winter residence: I found, however, on extending my observations, that the same fact occurred along a great extent of the eastern coast of Scotland, and that their arrival there was simultaneous with those in Northumberland and the coasts of the adjoining counties. I was also aware that it had always been esteemed indigenous in Scotland and its islands, and a permanent resident of its native localities. I therefore abandoned this supposition, and felt convinced that the strangers came from countries still more distant, and in which they were a regular migratory species. This con-

jecture received strong and satisfactory confirmation in the autumn of 1822, when I had the satisfaction of witnessing their arrival upon the coast, fatigued and spent by their distant and, for so diminutive and to appearance delicate a bird, almost incredible flight. This happened after a severe gale, which commenced on the 24th of October 1822, at NE., and continued during the whole of the 25th; but which, for some hours previous to its conclusion, veered about to the E. and S. of E. On the morning of the 26th they were seen to arrive by hundreds upon the beach, so fatigued ar d overcome by the unfavourable change of wind, the lengtn of their journey, or both combined, as to drop the moment they reached land, unable to make any further exertions. Great numbers were in consequence at first taken by the hand, unable to rise or escape their pursuers. Some idea may be formed of the incredible numbers which came over in this flight, furnished in all probability by the forests of the northern parts of Europe, when I mention that I have traced it to have extended from beyond Berwick northwards, along the whole line of coast as far as Whitby in Yorkshire; but how much farther to the north or south of these points I have not yet ascertained.

With the same gale we received a great importation of Redwings and Fieldfares, and a very abundant flight of Woodcocks, all known as emigrants from the northern parts of Europe; but none of these appeared to have suffered from fatigue to the same extent as their diminutive companions. As soon as they were a little recovered from the effects of their distant flight, they spread themselves over the country adjoining the coast, and at first filled every hedge and plantation; but they appeared still desirous to move southwards, and their numbers rapidly and daily decreased; and I remarked that, about Christmas, scarcely more than the annual average quantity remained.

Hitherto I had always considered, and indeed had found, the Regulus to be a permanent resident, even during the severest winters; but what took place last season, proves, that even those species which under usual circumstances, constantly inhabit their native localities, are compelled, by unusual and peculiar contingencies, to vary their habits, and become subject to those laws which direct the migratory movements of the feathered race. As I before mentioned, about Christmas their numbers appeared reduced to the usual standard, and they remained subject to observation till after the first severe snow-storm, which we experienced in the beginning of January 1823. They appear, however, to have had some presentiment of what was about to follow, as they left the country to a bird, during the short interval of thaw which took place previous to the commencement of the second storm, so severely felt throughout the northern parts of England, and a great part of Scotland. Expecting their return in spring, at the usual time they begin to breed, I looked for their reappearance with considerable interest; not a single pair, however, could I discover in all their accustomed haunts, long after the usual time of nidification, and when our plantations are wont to be alive with the stridulous song of the male; nor was a single Regulus visible in any part of Northumberland till October last, when a few arrived at the time I have before stated the strangers annually make their appearance, some of which I perceive still remain with us.

During an excursion in Scotland, in August and September 1823, I did not neglect to look for them in every likely locality, and in places where I had previously seen them very plentiful, but without success. Titmice I found abundant, particularly the Parus *ater* (Cole-mouse), which inhabits all the fir-forests and plantations; but I could not

discover the P. *cristatus* (Crested Titmouse), said to inhabit the Forest of Glenmore. This unexpected and unwonted desertion in all probability proceeded from some instinctive feeling, which impelled them to fly from approaching danger; but what causes prevented their return to their native habitats after the severity of the season was past, is a question not so easily solved. Among various surmises, it has occurred to me, that the late period of the season, or rather early part of the year, at which this migration took place, as well as the distance to which it extended, may have combined to prevent their return to their native haunts in sufficient numbers, or at the usual period they begin to breed; and that thus situated, they have been obliged to yield to the imperative demands of nature in those parts, or on their return from those regions to which they had been driven under such unwonted circumstances. What favours this supposition is, the very early period at which the Regulus begins to feel the influence of love, and to breed, for they very frequently pair towards the end of February. Their migration did not take place till the last week in January, which allows but a short interval to elapse before the amorous propensities would be in action, and these probably accelerated by the mildness of the climate in which they had taken refuge. I have not yet ascertained whether the Reguli of the southern parts of England were likewise observed to migrate, or if they were known to breed in their usual or in greater numbers during the last season, viz. that immediately following their migration from the north. Few, I am afraid, will be found to have paid the attention necessary to establish these facts, particularly as the object is of so diminutive a complexion, and offers but little to excite attention or remark, except to those ardently engaged in ornithological pursuits.

January 20. 1823.

XXIII.—*General Observations on Geology and Geognosy, and the Nature of these respective Studies.*

By the Rev. James Grierson, M. D.

(*Read 7th February* 1824.)

Some have thought that, in studying the sciences, the ancient Greeks had a considerable advantage over us moderns, on account of the peculiar terms by which scientific ideas are expressed, being mostly taken from their own language instead of a foreign one, and consequently more familiar to them. Thus the words Geology, Geognosy, Geography, Astronomy, Astrology, for example, are all we may say Greek, and would be as easily understood by a Greek novice when entering on the study of any one of those sciences, as Discourse of the Earth, Knowledge of the Earth, Delineation of the Earth, Laws of the Stars, Speech of the Stars, would be by an Englishman when he is entering on the same study. Now, whatever be in this (and we do apprehend there is not much in it), no doubt can be entertained, that the multiplication of terms unnecessarily,

and the inaccurate or vague use of them, are among the greatest obstacles to the advancement of true science. This remark has been thought to be peculiarly applicable to the science in which we are more immediately interested, and which it is the object of the Wernerian Society more particularly to advance. The introduction of many new terms has been objected to, as tending only to overload and perplex the nomenclature. I am far from allowing that the objection is in general well-founded, though there may, perhaps, be found a few instances in which it is; but my object at present is to shew, that the word Geognosy, as introduced by WERNER into the department of Mineralogy (and which has been much exclaimed against as unnecessary and superfluous), is by no means so. We all know, that, previously to him, there had been numerous attempts made to account for the present arrangement and state of the materials of which the globe of the earth is composed, or to show what particular agent or agents had operated, in the way of natural causes, to bring into their present form and situation the substances of the mineral kingdom. These attempts, which have been called Theories of the Earth, had, before the age of WERNER, proceeded upon by far too limited a knowledge of minerals, and had taken for granted a thousand things which the authors of the respective theories could by no means prove. They were, in fact, little more than fancies,—a sort of philosophical romances, which might amuse the imagination, but conveyed no real knowledge.

As was not unlikely to happen, the first theorists turned their attention more particularly to a great and remarkable event recorded in history (in the oldest history by far now extant), and of which we have also traditional accounts, more or less distinct, in almost every part of the world. They supposed the Earth to have been created in a certain

state (some of them in one, some in another), and then they set themselves to account for the changes which, in their opinion, a deluge of water would produce upon it.

Burnet, for example, in 1681, supposed the Earth to have been an immense abyss of water, covered by a smooth crust, which, being broken and deranged at the Deluge, produced, by its fragments, mountains, islands, and all the great irregularities we now perceive on the globe. Woodward, in 1702, fancied that, at the Flood, a suspension for a short time of the attraction of cohesion took place among the particles of all mineral substances, and that the globe, being thus, as it were, dissolved and converted into a soft paste, shells sunk into it, and so are now found in the heart of solid rocks, and at a great depth below ground. Whiston, in 1708, imagined that the Earth was formed from the atmosphere of a comet, and that the Deluge was produced by the tail of another! Others, paying less attention, or we may say no attention at all, to the accounts we have in Scripture, said the world was an extinguished sun, or a vitrified globe, on which, as it cooled, the vapours gradually condensed, forming seas and lakes, which afterwards deposited calcareous matter. Such were the fancies of Leibnitz and Descartes in 1683 and 1749. But a still more extraordinary fancy (Quid tam absurdum quod non dictum fuerit ab aliquo *Geologo*?) was that of Demaillet, who imagined the Earth to have been entirely covered with water for some thousands of years, and that men were then a sort of fishes, and lived in that element. Buffon's imagination seems to have been guided in its flight very much by that of Leibnitz. Both held the Earth to have been originally a fiery mass, gradually cooled down, and arranged so as to be at last rendered a fit habitation for plants and animals. Only Leibnitz will have it to have been an entire sun, while Buffon tells us it was only a

part of one knocked off by a comet. These are, no doubt, very fine specimens of closet world-building, worthy of being preserved in the cabinets of the curious. Delightful romances! But we have some still better—we have higher flights of the imagination yet on this subject. Later writers have supposed that every thing was originally fluid, and that this fluid was inhabited by an infinitely great number of infinitely small and simple animals and vegetables, which, by their exuviæ, in a course of ages, produced calcareous matter and other substances, forming the solid body of the Earth; so that the mineral kingdom, according to them, is no more than the debris or exuviæ of the animal and vegetable. The original or infinitely small monadic animals and vegetables, Lamarck, and others, who hold the same system, tell us, gradually acquired different habits, became larger and more diverse from one another; and hence all the animals and vegetables we now have. Others, again, such as Kepler and his followers, not content with peopling the globe with an infinite number of small monadic animals, and setting their debris and that of vegetables to form mountains and the other solid parts of it, have told us that the globe itself is one great animal, possessing sensation and volition, digestive and respiratory organs, in short, all the qualities of a living being! Fine examples these, we see, of geological speculation, which, if they do not evince much power of observation, or great accuracy of deduction, certainly shew no deficiency in power of fancy. But, *umbrarum hic locus est;* let us leave these purely imaginative philosophers for others of a more sober cast,—others, who would look upon themselves as degraded,—indeed, as grossly insulted, to be placed among what we may call the pretty *novelistic* geologers. And yet it does appear that some of these, even of these soberer ones, hold opinions little, if at all, less strange than certain of those we have already enume-

nated. Delametherie, for instance, thinks that almost every thing was formed by crystallization. Dolomieu will have it that immense currents, of many hundred fathoms deep, swept at various periods the bottom of the ocean, and from thence throwing up sand and shells and other substances, deposited them upon the continents, to form hills and mountains. M. de Marschall, as late even as 1802, has informed us, that the superficies or outer crust of our globe is made up of a variety of fragments, which at different times fell down from heaven in the way of meteoric stones, and, as a proof of the same, refers us to the exuviæ of the unknown animals now found in the strata.

In the very same year with this discovery, the scientific world was called upon to believe a truly sublime and beautiful doctrine, namely, That there exists in the central parts of the earth an immense fire, or source of heat, which at certain periods breaks out, and acts with intense and irresistible violence, after having lain dormant for an indefinite number of ages;—that the matter of the different continents and islands over the world being constantly washed down by the rains, and other wasting processes of the atmosphere, into the rivulets and rivers, is by them conveyed to the sea, and ultimately to the deepest parts of it; and that, when this is sufficiently accomplished, and an abundant stock of mud and other things is there deposited (which probably takes place in some millions of millions of years), the great fire begins to burn, and, under the immense pressure of the waters of the ocean, bakes, as we may call it, the stuff, melting or at least softening it;—that then the fire for a time ceases or goes out, permitting the materials to cool, and so form strata;—that when this has happened, and the strata are sufficiently hardened or consolidated, the fire lights itself up anew, and, in a far more furious and irresistible form than before; not waiting, as it did in time past,

to melt or soften the materials on which it acts, but violently heaving them up in a broken and dislocated state, along with fluid granite and trap, through the ocean, thereby causing, of course, its waters to flow off towards the former land;—that this takes place with such inconceivable force and fury as to turn the whole of the former continents with their inhabitants into the bottom of the sea;—a new continent, or continents, and islands, are thus formed out of the elevated bottom of the ocean, and the fishes and apoda turned off from their former quarters, to frisk about on that portion of the earth's surface which formerly belonged to the terrestrial animals, the fate of which may be easily conjectured:

> "Occupat hic collem; cymba sedet alter adunco;
> Fiet lupus inter oves: fulvos vehit unda leones,
> Unda vehit tigres: nec vires fulminis apro,
> Cornua nec ablato prosunt velocia cervo."

Such was the creed of the late celebrated Dr HUTTON of this place, as illustrated by the late, no less celebrated, Professor PLAYFAIR,—a gentleman, this last, remarkable for his many and valuable accomplishments, but for none more than for the elegance and felicity with which he always expressed himself when he wrote on subjects of natural science. His master in geology (I mean HUTTON) had sublime and extensive views, but he could not clearly exhibit them to the minds of others. No man ever stood more in need of an illustrator, and no man ever found a more admirable one than he did in the person of his pupil. But what proof have we that a central fire exists? And what proof have we that the materials carried down by the rivulets and rivers are ultimately deposited in the bottom of the ocean? I can perceive none,—not even of this latter position. Everywhere do we see holms, and carses, and bars, and deltas, thus formed at the mouths of rivers, but

no evidence can I perceive that the materials go farther. The first principles, therefore, of this theory are, like those of the others at which we have been looking, in my opinion, purely gratuitous.

WERNER, as I have already hinted, and as is well known and acknowledged, was the first to introduce into this subject what may be called the truly inductive method. He taught us, that, before drawing conclusions, we should look at the objects before us, and should make ourselves acquainted with their distinguishing properties, before we attempt to explain their formation: in short, that we should become mineralogists before becoming geologists, or know of what the earth is made, before we pretend to tell how it was made. On these principles of true and legitimate mineralogical philosophy, so happily introduced by him, and now so generally acted upon by his numerous, I had almost said innumerable, pupils throughout the world, the science is making such unprecedented and rapid advances, as that it may be expected soon to comprehend a pretty complete knowledge of the unorganised kingdom, at least as far as this ever can come under our observation. Nowhere, however, I think I may, without an approach to flattery, say, have the Wernerian, or truly scientific methods of investigation in this department of nature, been followed with more ability, and attended with greater success, than in our own country; and when I say so, no one can fail to perceive that I allude to our President. But though WERNER and he, and the immediate successor of WERNER, not to mention any more, have indisputably put us on the right road, and also conducted us a great way along it, surely it would be rash to affirm that every thing has been accounted for, and that the science of mineralogy is already perfect. Certainly no. Many things, after all that has been achieved, still remain unexplained, and there

is abundant room for future discovery. I do not, however, look upon the great merit of the system of Werner and his disciples as arising from the satisfactory manner in which it enables us to explain the *formation* of minerals (though in this respect, also, it certainly appears to me to be greatly superior to every other that has yet been introduced); I consider its merit as arising chiefly from the facility and certainty with which it enables us to distinguish the objects of the mineral kingdom from one another, or to arrange and classify them. This is the principal point. No doubt, it would be satisfactory, aye, inexpressibly gratifying and delightful, to know the particular way in which every object in the mineral, as well as in the other two kingdoms of nature, was formed. "Felix qui potuit rerum cognoscere causas," is a principle deeply seated in the human breast, and of which we all very powerfully feel the influence. But I am afraid the desire of gratifying it not unfrequently leads us astray. What but this desire, operating in an excessive manner, led to all the fanciful theories and singularly extravagant positions, which I have already taken notice of, with a great many more of the same sort, too tedious to mention?

Mineralogy and Geognosy have, I think, abundant interest in their investigations, independent of the manner in which the objects about which they are conversant were formed. To know and distinguish these, to arrange or classify them; ascertain their properties and relations, so as that when we find one, we may in some degree know where to look for another; to ascertain their uses; to find whether there is any order in the structure of the earth on the great scale, and if so, what it is;—these, I should think, are subjects sufficiently attractive and interesting to any philosophic mind, and this is perhaps all the length we shall ever be able with certainty to go in the path of the

science of which I now speak. For the subjects about which we reason are so hid from our view, and so completely beyond the reach of any thing like a thorough investigation, that it is nearly as unlikely we shall ever fully ascertain the manner of their formation, as it is unlikely we shall ascertain whether there are inhabitants in the moon or no. The subject, however, certainly has abundant interest without this, without any speculations and conjectures about the modes of original formation;—as much interest, I believe, as Botany has, or Zoology, or even Astronomy itself. Now, what botanist, or what zoologist, when he finds a new plant, or a new animal, puzzles himself and his readers, by endeavouring to ascertain how it was formed, or how it came to be in the place in which he found it? It is sufficient for him to know what place in his system the plant or the animal is to be referred to, what are its distinguishing properties, what are its uses, economical, medical, or ornamental. So in Mineralogy. It is sufficient, I conceive, to ascertain the distinguishing properties and uses of a simple or compound mineral, of a rock or a mountain, a stratum or a vein. Why speculate, and fancy, and suppose, and take for granted, and bring our science into contempt, by what are called Theories of the Earth? Werner, in the comprehensiveness of his mind, seems to have felt this impropriety, and, in order to avoid it, introduced the term Geognosy, by which he meant to distinguish the legitimate and useful department of the science of Mineralogy, or rather of Geology, from the purely fanciful and useless part of it, which consists in pretending to explain how the Earth was at first formed, and how the successive changes it may have, as a whole, from time to time, undergone, took place. Geology he leaves to express this, which it had been too often understood to do (though Geogony is the more appropriate term); and

Geognosy is understood by him to indicate the distinguishing, grouping, or classifying, on the great scale, the various substances which constitute the exterior parts or crust of the globe, that is, all that portion of it of which we ever can come to the certain knowledge. For that we should pretend to speak of what is at the centre, or in the interior of the Earth, is nearly as absurd, I think, as it would be (according to the shrewd observation of a worthy gentleman, now no more) to pretend to tell what is in the inside of an orange by slightly scratching the rind. The deepest mines have certainly not penetrated to any thing like a mile into the Earth, and though they had reached thus far, it would be only about the four thousandth part of the distance from the surface to the centre. But I believe the deepest mines have not gone down more than a quarter of a mile, or about the sixteen-thousandth part of the earth's semidiameter. Therefore we can no more know by all our investigations what is at the centre of the earth, than we could know what is at Glasgow or Perth (if we had never been at either of those places, or had any information concerning them), by moving four or five yards from the place in which we now are. I certainly think it of much consequence that the object of mineralogical study should be rightly understood; for I have met with not a few who seemed to undervalue or avoid it, merely because they had formed a wrong notion of the subject; and, instead of considering this science as the means of becoming acquainted with the qualities, relations, and uses of the substances of the mineral kingdom, looked upon it as nothing more than a tissue of vain and unprofitable conjectures about the original formation of the world.

XXIV.—*On the Mode of Growth, Reproduction, and Structure of the Poison-Fangs in Serpents.*

By Dr Knox, F. R. S. E.

Conservator of the Museum of the Royal College of Surgeons, Edinburgh.

(*Read 24th January* 1824.)

At an early period of my researches into comparative anatomy, I was led to examine with considerable care the anatomy of a class of animals, dangerous and terrible in their nature, and against which man has declared perpetual war. Dwelling for a long time in a country abounding with these reptiles, and where, during a great portion of the year, by infesting our gardens, houses, and fields, they formed a subject of daily conversation, I was naturally led to inquire into their structure, and even, so far as was practicable, to pay attention to their natural history; but my researches were chiefly of a practical nature, and directed more towards detecting the presence of those organs which have procured for their possessors the hatred of every living animal. Minute and careful dissections, performed lately, have shewn me, that a few facts, in the anatomy and physiology of the poisonous teeth of serpents, had escaped

my notice; and viewing the subject as one of general interest, I have ventured to call the attention of the Society to the following brief history of these organs.

All anatomists are aware that the serpents called poisonous possess two kinds of teeth; viz. numerous simple teeth, implanted in rows into the lower maxillary bone, and into the palate-bones of the upper jaw,—and, in certain species, to be described afterwards, into the upper maxillary bone itself; these are employed by the animal in laying hold of its prey. These teeth have, I believe, generally been considered permanent; but this opinion I do not consider correct, because they are found to vary in number even in the same varieties, and because I have observed *unattached* simple teeth in the rattle-snake,—that is, simple teeth of rather a soft texture, placed obliquely betwixt the fixed teeth, and attached to the maxillary or palate bones by soft parts only.

In several innoxious snakes now lying before me, there exist two distinct rows of simple teeth, attached only by soft parts to the maxillary and palate bones, running parallel with those already fixed into the bone. These supplementary rows of teeth are placed internally with regard to the fixed ones in the maxillary bones, but externally to the same in the palate-bones. They seem to me in a perpetual state of growth, and advance to supply the place of those which the animal casts by a regular process of nature, analogous, no doubt, to the mode of dentition so long ago observed in certain fishes, as the shark, &c. Moreover, the lower maxillary and palate bones, around the bases of the tooth, have the same loose, cellular and vascular appearance as that portion of bone to which the fangs are attached, and which will be described more particularly in a future part of the paper. A section of the jaw-bone demonstrates, that, when once the tooth has become fixed, its mode of

nutrition alters, as it now receives its nourishing vessels from the centre of the bone itself, through which may be traced a canal filled with soft parts, and communicating by a large orifice with each of the fixed teeth. The periods at which the animal casts or sheds these teeth are unknown to me, but one would naturally conjecture that it may be annual: the subject is open to the inquiries of the naturalist.

It has been already observed, that the simple teeth, even in poisonous serpents, are not confined to the lower maxillary bone and to the palate-bones in the upper jaw, but are found in certain serpents, implanted also into the superior maxillary bone. Mr Schreider first noticed them in the Hydrus or Water-Snake; and they have also been found in the *Boa fasciata*, *Boa lineata*, &c.; likewise in the serpents called *Trimeresures* by the Count Lacepede. These have with propriety been separated from the other venomous serpents, or those which have only poison-fangs in the upper maxillary bone, and which have been arranged by naturalists under the classes *Crotalus* and *Vipera*. The essential character of this class is, their having only poisonous fangs in the superior maxillary bone, and, consequently, in having the simple teeth confined to the palate-bones in the upper jaw, and in the lower to the inferior maxillary bone. I have found this character unequivocal and constant in all the poisonous serpents I examined in Africa; in the Rattle-Snake, in the common Viper of this country: but I was surprised to find that several varieties of snakes, described by Mr Russel as varieties of the celebrated *Naja*, or Spectacle-Snake of India, have simple teeth implanted in the superior maxillary bone. I first observed this fact in a specimen of a snake given me as a Cobra, and which belonged to an Indian collection sent to the Museum. On observing that there existed a simple tooth in each of the

upper maxillary bones, in addition to the regular poison-fang, I was inclined to think, that, in consequence of the specimen having been somewhat mutilated, its real character might have been mistaken, and that it probably belonged to the Trimeresures of Lacepede. On appealing, however, to the specimens in the Museum, I found that the Indian snakes called Cobras, and which agree very accurately with the descriptions given by Mr Russel of certain varieties of the *Coluber Naja*, or Spectacle-Snake, uniformly possess simple teeth, growing on the upper maxillary bone; and hence these serpents can no longer be arranged with the vipers, but ought either to form a distinct genus, or be classed with the pseudo *Boas*, or *Trimeresures* *. In a real *Pseudo Boa* †, now in the Museum, I find three simple teeth in the upper maxillary bone. In a common variety of the *Coluber Naja*, there is only one fixed simple tooth belonging to the same bone. In the *Hydrus* (which I have not yet examined) there are several. All these species are East Indian, or at least belonging either to the continent itself, or to the islands scattered over the Indian Ocean. It would be interesting to know, if the circumstance of having both kinds of teeth in the upper maxillary bone be confined to serpents from these countries only ‡.

* The variety examined by me, and of which there exist several specimens in the Museum, is the *Nella Tas Pam* of Russell. I have not yet had an opportunity of examining a specimen of that variety whence the whole family derives its name. It has appeared to me that the Indian snakes generally have the poison-fangs much smaller than the African and American; but this does not seem to have any influence over the terrible poison destined to pass through them.

† Called in Bengal "Bungarum-pamma."

‡ I have placed on the table the crania of three species of snakes, arranged according to their teeth, viz. the cranium of a perfectly harmless snake having simple teeth only; that of a Cobra or Spectacle-snake, and the cranium of a truly poisonous one, said to have come from the East Indies, but which bears the closest resemblance to the common Puff-adder of Africa.

The other kind of tooth with which the poisonous serpent is armed, is the fang, placed in the upper jaw on either side, and firmly fixed into a small moveable bone, generally considered as the superior maxillary. Two muscles moving this bone, and so contributing to give motion to the fangs, pass through the poison-gland, situated immediately below and behind the eye, so that by one and the same action the fangs are driven into the animal or object attacked, and the poison is forced from the central cavity or collection of cells in the gland into the duct by which it is conveyed to the base of the fang, and thence into the canal of the tooth. The structure of the bones, into which the fixed or active fangs are inserted, is very peculiar; nor do I remember to have found its analogy any where, excepting in some fishes. The lower surface of the bone, or that which regards the mouth, and into which the fang is fixed, presents a considerable cavity, divided, as it were, into two portions, into one of which a poisonous fang is fixed,—the other cavity being reserved for the supplementary tooth intended to fill it at some future period. The edges of the bone are unequal; and its base exceedingly vascular, dark-coloured, and, as it were, cellular, and is apparently undergoing a perpetual decay and renovation on its margin. A very remarkable, and so far as I have observed, a constant appearance is, that, on one side of the jaw, the cavity for receiving the supplementary tooth is external, whilst on the other side it is internal; or, which comes to the same thing, the poisonous fang is fixed on one side into the external portion of the upper maxillary bone, whilst on the opposite side it is fixed into the internal portion of the corresponding bone.

I have already remarked, that there is always ample room for two fangs, though most generally there is but one fixed on either side. In a future part of the paper, I have

taken notice of the head of a common viper, in which I found two poison-fangs fixed into either maxillary bone; but such an occurrence must be exceedingly rare, for of the vast number of poisonous snakes I have examined in this and in other countries, the viper alluded to is the only instance in which I have met with it.

Whatever be the situation of the fixed fang, there will always be found a rudimentary one, partly attached to the bone, and preparing to occupy the vacant space described above, and to replace the old tooth, whenever by age or other causes the latter may have been detached from its socket, and separated from the animal. But previous to describing the mode in which we may suppose this process of decay and renovation to be effected, it is essential to explain to the Society the real structure of the fangs themselves.

It is, I think, sufficiently well known, that, in addition to the fixed poisonous teeth, serpents possessing these dangerous organs have others which may be called rudimentary; that is, they have on either side, close to the fixed fang, and suspended to the upper jaw, a certain number of teeth, intended by nature to supply the deficiency in the fixed teeth, whenever these shall have been shed or lost. The rudimentary teeth I speak of, are entirely surrounded by soft parts, each inclosed in a separate sheath, and cannot be seen without dissection. They seem to me to be in a constant state of growth, and indeed present a regular series, from a mere horny point to a tooth, nearly equalling in size, strength, and hardness, the one actually employed, and at the time fixed. We may either consider the tooth as it first appears, tracing it through its various stages to the full-grown tooth, or *vice versa*. The first mode seems the most natural, and it is the one I shall adopt.

At whatever time a poisonous serpent is examined, there

will generally be found a rudimentary fang, so small, that it is nearly of the same form and structure as one of the common palatine or maxillary teeth; that is, it is composed of a horny substance, or enamel, and has a single cavity, in which is contained the nourishing pulp, or model, as it were, of the tooth. The tooth itself is exceedingly soft. The rudimentary fang, which we shall consider as next in succession, because next in size, has already assumed a different appearance. At its base may be seen a part of the anterior opening, or that through which the poisonous fluid is afterwards to pass: this little cavity or opening already contains a pulp. The third tooth, reckoning always by the increasing size, shews a much more complex structure, for the tooth growing continually from its base, the anterior opening is entirely formed. The external and convex cortex of the tooth has become consolidated immediately behind the opening; but near the base a line may readily be perceived, extending to the soft parts at the base of the tooth itself. This line, in some teeth, strongly resembles a fissure; but I have never found it to be really so, in the rattle-snake, or in the fangs of those serpents which, by reason of their size, could be easily examined. It is not improbable that, during the very early and soft state of the tooth, it may be partly open. As the tooth grows, the enamel on its convex external surface closes constantly behind the anterior opening, and advances gradually towards its base; whilst, at the same time, there arises a firm, horny, or osseous lamina, which, proceeding from the convex surface of the poison-canal, divides the external cavity, or that containing the nourishing pulp of the tooth, at this point, and, indeed, throughout its whole length, into two equal parts. A section, therefore, of a tooth, at this stage of growth, will present a variety of appearances, depending on the situation of the section. If

made at a short distance from the anterior opening towards the base of the tooth, there will be seen, first, the central osseous canal, the future channel for the poison, but which is in the present stage filled with its nourishing and formative pulp or mould; *2d*, A circular space surrounding the poison-canal, inclosed by the external parietes of the tooth, and containing also its nourishing pulp; *3d*, A vertical osseous or horny lamina, proceeding from the convex side of the tooth to the poison-canal, and dividing this cavity, superiorly, into two equal parts. But immediately behind the anterior aperture, the convex part of the poison-canal has united so firmly and closely with the parietes of the tooth itself, that the vertical lamina is scarcely discernible. The reason of this is, simply because the poison-canal presents throughout a calibre of nearly equal dimensions, whilst the tooth itself is constantly becoming more and more tapered towards the point; the parietes, consequently, of the respective canals soon approach each other, and at last are united; the cavity, also, for containing the nourishing pulp of the tooth, becomes gradually less and less, and is more confined to the concave side of the tooth. If the section be made near the base of the tooth, that is, where the enamel has not become consolidated, the vertical lamina is quite cartilaginous, and very thin, but always exists; *so that the external nourishing pulp at no period of the growth, uninterruptedly surrounds the poison-canal.* Moreover, it is here to be remarked, that *the poison-canal is never open on its convex surface;* but that, on the contrary, its parietes form at all times a completely circular canal, containing at an early period its formative pulp, and, afterwards, poisonous fluid itself. The fissure which, at a very early period of the growth of the tooth, may be seen on its convex side, is quite closed, even in the rudimentary fangs, long previous to the formation of the aperture at the base;

and the vertical or ascending lamina is in consequence completely formed. The convex surface, moreover, of the poison-canal is at all times stronger and more compact than the lateral or concave portions. In one of the preparations now before me, there is an appearance indicating that the vertical lamina becomes first ossified on the side of the poison-canal.

The opening at the base, by which the poison is at a future period to pass into the poison canal, is formed in a similar way with the anterior aperture or outlet, yet there are certain differences arising out of the functions which the tooth must afterwards perform. The principal of these is the imperfect state of the aperture at its base, which can scarcely be called complete, and, indeed, is in some measure rendered so only by its insertion into the maxillary bone. Anterior to, and on the sides of, the aperture, at the base of the fang, the external parietes of the tooth becomes very strong; they are firmly united to the edges of the poison canal, and consequently, the greater portion of the nourishing pulp of the tooth is thrown towards the concave side; but there still exists a very thin layer of pulp on the sides and lateral convex aspect, *excepting always in the site of the vertical lamina, or uniting plate of the two canals.* As the fixed fang is detached by a process which I shall immediately endeavour to describe, the rudimentary one, which has now attained its full growth (though not its hardness), becomes gradually fixed into the cavity on the lower surface of the upper maxillary bone, externally or internally, and by adhering to the edge of this bone, and, at the same time, advancing forwards, the source of nourishment of the pulp belonging to the poison canal is cut off, the portion of pulp at the time in the canal dies and wastes away; and thus, for the first time, the osseous tube destined to give passage to the poisonous secretion becomes pervious.

But it is carefully to be kept in mind, that this osseous tube *has neither furrow nor fissure, but is at all times complete.* It is probable that, in the mean time, the other tooth is detached, in order to be thrown off, by a process exactly similar to that by which the poison canal is formed; but the process of decay and renovation, or the loss of one tooth and its replacement by another, does not seem to be in any way influenced by mechanical laws, or to be necessarily connected with each other as cause and effect, for I discovered and carefully preserved the head of a common viper, in which there are two fangs firmly implanted into one maxillary bone. It would seem that the replacement of the teeth takes place at fixed, though unknown, periods. The sections of the full grown tooth present certain differences from those described in the rudimentary ones; if we commence, for example, near the base, and cut the tooth across, in the situation of the opening at the base *, it will seem as if the poison canal opened on the convex surface; but at every point anterior to this, or towards the point of the fang, the section will present a complete central hollow tube or canal, nearly circular, surrounded, excepting at one point, by a pulpy matter (itself inclosed by the external parietes of the tooth), and therefore not continuous, being separated on the convex side of the tooth by an osseous vertical lamina, connecting the poison canal and external containing case of the tooth together.

The rudimentary teeth are found to vary in number, which may probably depend on the age of the animal. In the common Viper of this country, and in the Puff-Adder of Africa, I have generally found five; in other venemous serpents, four; in the Rattle-Snake, five; in some Cobras,

* See the Figures in Plate X.

three; &c. It is chiefly in the teeth of the Rattle-Snake * that I have observed the facts detailed in this paper, but I have also noticed the same appearances in some others, more particularly in the head of a large serpent, said to be Indian, but closely resembling the African Puff-Adder. In some of the larger Cobras, the same appearances present themselves, but it is more difficult distinctly to make them out, by reason of the smallness of the poison fangs compared with those of the Rattle-Snake. I have thought, from some specimens examined by me lately, and more particularly, from the one I now present to the Society, that the apparent fissure extending along the convex surface of the fangs in the Rattle-Snake may be forced open mechanically, even in the fixed fang, (for I do not suppose that there is ever actually a fissure in the fang of the Rattle-Snake); still there is no appearance of the poison canal ever being open on its convex surface †. The teeth in this serpent are extremely brittle, and split longitudinally, whenever we attempt to cut them.

The figures in the attached drawing are intended to explain most of the anatomical facts mentioned in the paper: they were sketched from preparations now in my possession.

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* Crotalus durissus.

† It is easy to satisfy one's self of the accuracy of this, by paring away the concave part of the tooth, and of the poison-canal, and examining the inner surface of the remaining convex portion; it will then be quite evident that the poison-canal is never open on its convex side, excepting in the situation of the openings, for the entrance and escape of the poison. The vertical lamina, and its firm union with the parietes of the tooth and of the poison-canal, is best seen by paring away the sides of the tooth, and leaving the convex part and the whole of the poison-canal entire.

Explanation of Plate X.

Fig. 1. Shews the tooth of the Rattle-Snake at an early stage of its formation. The line marked *a*, on the dorsal or convex side of the tooth, is already completely ossified.

Fig. 2. The tooth farther advanced in its growth. The line, or supposed fissure, is firmly ossified at *a*, that is, near the anterior aperture of the poison-canal; but even at *b*, where the parietes of the tooth are quite cartilaginous and soft, the line is not open, but perfectly closed. *c* marks the soft parts at the base of the tooth.

Fig. 3. A portion of the external parietes of the tooth has been removed, by which the cavity (*a*) containing its pulp is exposed. *b* marks the vertical or ascending lamina, uniting the poison-canal on its convex side to the inner surface of the parietes of the tooth. At no period is the poison-canal open, but at its extremities.

Fig. 4. The tooth of the Rattle-Snake in a still more advanced state of growth. The aperture at the base, for the admission of the poison, is just formed; but the line on the convex surface is closed throughout, even at *b*, immediately anterior to the aperture.

Fig. 5. The tooth fully formed, but not yet fixed. A portion of the external parietes and pulp has been removed, exposing the poison-canal, *a*. The nourishing and formative pulp of the tooth is found chiefly on the concave side, at *b*. *c* marks the aperture at the base.

PLATE X.

Fig. 7.

Fig. 8.

Fig. 6.

Fig. 9.

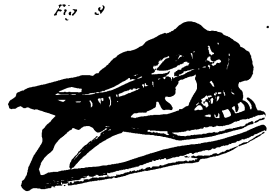


Fig. 5.

Fig. 3.

Fig. 4.

Fig. 2.

Fig. 1.

Lizars sc.

Fig. 6. A section of the tooth in the aperture at the base. *a*, the aperture leading into the poison-canal, and forming its commencement; *b*, the canal for the pulp of the tooth.

Fig. 7. A section of a full-grown tooth, about the middle. *a* marks the cavity containing the pulp; *b* the poison-canal; *c* the vertical or descending lamina, connecting the poison-canal and external parietes of the tooth to each other.

Fig. 8. A section of the tooth immediately anterior to the aperture at the base, shewing that the vertical lamina is at this point scarcely apparent. The same may be said of a section immediately behind the anterior aperture.

Fig. 9. Represents the cranium of a variety of the Cobra, or *Coluber Naja*, the Spectacle-Snake of India. Simple teeth may be seen growing on the same bones with the poison-fangs; on one side the poison-fang is fixed into the external portion of the maxillary bone, whilst on the opposite side it is precisely the reverse.

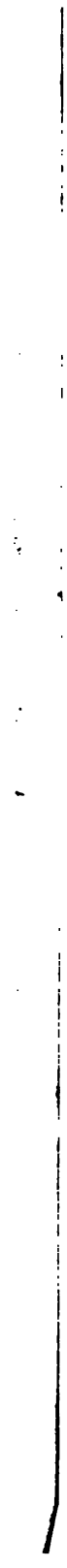
XXIV.—*On the Superficial Strata of the Forth District.*

By Alexander Blackadder, Esq. Civil Engineer.

(*Read 15th May* 1824.)

THE soils and subsoils, or softer superficial strata, in the district of the Forth, having occupied much of my attention during a course of professional labours, it occurred that the following remarks might be of some use in relation to the matters treated of in the paper on the *Sandfield* of the vicinity of Edinburgh.

From Borrowstounness to Gartmore, at the upper extremity of the valley traversed by the Forth, the common soil is *carse* clay, a substance well known as forming a rich level surface of considerable extent on the banks of the Forth and the Tay. (See specimens, No. 23. and 24.) Through this the river winds a sluggish course until it meets the tide above Stirling, from which point, to Gartmore, the rise probably does not exceed thirty feet. The only considerable streams which fall into the Forth, above Stirling, are the Allan and Teath; both of which, after



Engd. for the Wern. Memoirs Vol. V. P. 425

MAP

SHEWING THE DISTRIBUTION OF THE

ALLUVIAL DEPOSITES

IN THE

DISTRICT OF THE FORTH

W. H. Lizars sculp.

traversing with rapid currents the *old red-sandstone*, as expressed on the annexed Map (Plate XI.) enter the margin of the clay about one mile before they join the Forth. The former transmits about as much water as the Forth, the latter considerably more than that river *.

The district of the Forth may be divided into upper and lower, separated by the gorge at Stirling, formed by approximation of the hills, narrowing the carse-ground or valley to one mile. The rocky substratum of the upper district consists, probably throughout, of the old red-sandstone, which, dipping southwards, is lost under the clay and subordinate gravel, which occupy the valley. This arrangement is presented by the sections formed by the Teith, Allan, and Forth, and tributary streams; also at excavating the ornamental river, and in forming the elevated aqueduct at Blair-Drummond, passing from the higher marginal gravel, and proceeding into the clay of the valley.

This extensive upper district presents to the eye one uniform plain, the central parts occupied with mosses, whereof large portions have been floated off to the river by means of water introduced for that purpose, into which the peat-earth is thrown, so as to leave the clay fit for the purposes of agriculture. During these and other operations the nature of these mosses and subsoils has been unfolded. The clay of this district, presenting a uniformity of surface, is of varied quality. In so far as exhibited, by a very few deeper operations, its depth does not exceed twenty feet. Stones and pebbles of any description are unknown through its whole extent, but it reposes on small gravel, sand, red

* This map is formed on the principles pointed out in a paper by the President of the Society, printed in Vol. I. of their Transactions; the exterior line, of a deeper tint on the margin of each colour, expressing that the particular stratum reposes on the one contiguous.

till, or red *tilly* earth, as the case may be, which rest on the old red sandstone.

The mosses alluded to have preserved the remains of an ancient forest, chiefly oak-trees, which had occupied the plain but little above the surface of the river during ordinary floods, part whereof appears to have been lower and marshy, across which a road had been formed of trees laid longitudinally, with a second layer transversely. The depth of Blair-Drummond Moss (in which this road occurs), prior to the operations, was eight feet, extending to fourteen towards the upper extremity. Some of the roots of the trees were very large, and occupied their natural position in the soil, their trunks being extended horizontally, many retaining distinct impressions of the axes employed in felling them;—an operation commonly referred to the period of the Roman Conquest *.

These remarks on the upper district apply equally to the lower district and its mosses. But although the carse-clay soil presents in both the appearance of an extensive level plain, it is perhaps nowhere perfectly horizontal. It contains depressions, elevations, and inclined planes, which, to a certain extent, seem to have modified the course of the Forth, assisting in the formation of those meanderings which distinguish it, and which, particularly on the exterior margin of its numerous circular sweeps, encroach on the higher banks, presenting perpendicular sections on that side, and leaving low ground on the opposite, commonly embanked against the higher tides. In the lower district, the carse-clay has been remarked from 30 to 70 feet in thickness, at sinking wells near Stirling and Bothkennar. It reposes on sand, gravel, dark-blue *till*, or immediately on rocks of the Coal Formation. In both districts, the

* See "Encyclopædia Britannica," article 'Moss.'

sand, gravel, and till-clays, emerge from under the carse-clay at its margin on all sides, ascending often to an elevation considerably above it, forming knolls, ridges, and inclined planes. On the Map, the carse-grounds are expressed by *yellow*, the sands and gravels by *pink*. The bounding line is discontinued at those points of the last, where particular observation has not been extended.

On digging these wells sundry vegetable remains were observed, consisting of wood, hazel-nuts, and leaves of trees, in good preservation, occurring at various depths, interstratified with large gravel, clay, sandy clay, and sand, the last furnishing abundance of water, to which the clay may be considered as impervious. There are similar appearances at Drip, in the upper district, in passing fourteen feet through the clay into sand, reposing on the margin of a knoll of red sandstone. At Alloa, also, timber and other land products occur in sinking pit-shafts through the carse-clay to the coal-rocks. In that quarter, and at the mouth of the Carron, some transference of the soil may be supposed to have occurred, and a portion of the soft clay, or sludge, uncovered at every tide, may have been deposited in natural hollows. At Alloa, the tides form rapid currents during a portion of every efflux and reflux. But in other places, where the surface presents small depressions, not exposed to be flooded by any considerable stream, the clay immediately under the vegetable mould is a fine tint of blue, indicating that it had suffered no disturbance or mixture. Of this description, at B on the Map, occupying a small plain on the margin of the Carse, slightly depressed, is that in which the skeleton of the whale was imbedded, at Airthry. Hardly above the level of the river, from which it is separated by more elevated ground, a small rill passes from the adjoining hill, which, stagnating, may have produced the covering of peat-earth, much thinner than the

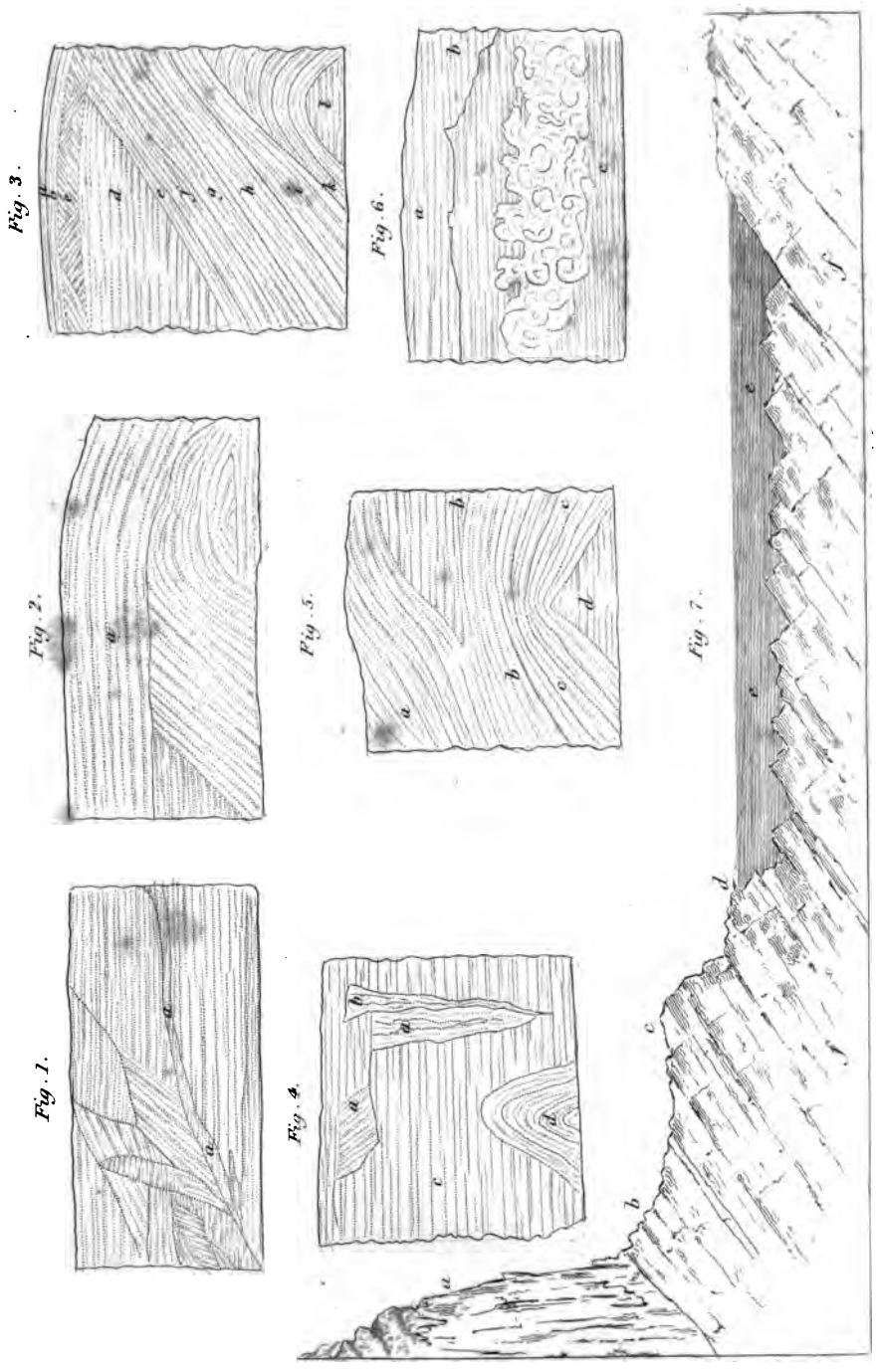
mosses of either district. I have particularised these hollows, because in the points which were at all seasons free from flooding, the roots of vegetables, with the operations of insects, producing a more spongy texture, and affording access to the influence of the sun and air, a more equivocal description of clay is presented, approaching to vegetable mould. Undisturbed clay is further indicated by alternating thin parallel layers of blue and brownish clay, in which occur, in both districts, many extensive deposits of marine shells, disposed conformably to the layers. Their localities, with other remarks applicable to the general subject, shall next be noticed.

Sp. 1.—Below Polmaise, the south bank of the river presents sundry sections of the carse-clay. Near Fall-in, is a section of 14 feet: under the soil-cover, 8 feet of the alternating stratification, formed by extra proportion of quartz-grains, oxide of iron, and mica-scales; declination E. 5°. Beneath this, a layer of shells occupies the clay, from 6 to 8 inches in thickness, same as in specimen. It also contains in abundance the roots of *paddock-pipes* (the *Equisetum*), which plant is frequent in the surrounding fields. These roots do not appear under this layer. Some of them penetrate into the interior of the shells. Under this lies a conformable stratum of peat-earth (14 inches), sides parallel, containing numerous fragments of the rind of an aquatic reed, compressed longitudinally; also small pieces of wood, and fragments of bark; but no trace of the moss-plants, or bog-plants, which form the superficial mosses of the valley.

Sp. 2. is from this stratum, situate 6 feet above high-water mark: under it lies a more compact and bluer clay. Eastward 300 yards, the bank presents a similar disposition, with declination E. 3°. In all these the shells consist of the kinds most common in the Frith and sea-coast. Many of the bivalves occur shut and empty, excepting a

PLATE XII.

Wern. Memoirs Vol. V. p. 429.



W. H. Lizars sc.

minute portion of orange-coloured matter. Similar remarks apply to the shells of the upper district.

Sp. 3. Clay immediately over the shell-layer. The general features of this lamellated clay under high-water mark are shewn in Fig. 1. Plate XII.

Sp. 4.—Clay from *a a* being darker when recent, than the adjoining. The colours refer to its appearance, when *moist*, Fig. 1.

Sp. 5.—Shells from clay-section of 10 feet, formed by the river at Ross, opposite Meiklewood, upper district, included in eight parallel layers of the clay, occupying about as many inches. The layer immediately under, so closely resembles clay-ironstone in colour, and angular *fracture* (if the term be admissible), that it might be, at first sight, mistaken for it, although but little harder than the others. Dip 3° N.; declination 2° E., descending more rapidly at the east end, where it presents the following general features: Fig. 2.

a, Position of shell-layers.

Sp. 6.—Shells found in abundance in surface-drains at Drip farm. Shells similar to these are found in the carse-clay at many other places, some of them ten miles farther up the valley: Also in the lower district, at Grangemouth, in strata 12 inches in thickness, which crop out in sundry places.

The following Specimens and Remarks relate to the Sand and Gravel Deposits which appear on the margin of the Carse-Clay of the Lower District.

At Ballasthill sand-pit, near Canal-bridge, Falkirk, a knoll of sand and gravel is wrought for ballast, and presents a section about 40 feet by 300 in length. Towards the

right it is in depth 20 feet, and passes into blackish clayey earth, the upper part ochreous. Twelve yards farther, its upper portion passes into clayey till, and its under into very compact till; colour almost black, without pebbles, and impervious, naturally dividing into rock-like fragments.

Sp. 7.—Into this *till* the orange-coloured ochreous matter passes horizontally, 1, 2, and 3 feet, in veins, which, commencing $\frac{2}{8}$ths or $\frac{3}{8}$ths of an inch in thickness, with well-defined edges, proceed in an angular or zigzag course, tapering to their extreme points. In dimensions, shape, and common direction, they correspond; but their angles are all dissimilar.

Sp. 8.—A selection of pebbles from the knoll, including the varieties. There are no traversing veins or slips. Many of the stones are rolled spheroids, chiefly soft coarse sandstone, of an earthy-brown colour; and from six to twelve inches in diameter. Yet the interior features of this knoll are manifestly regular.

Sp. 9.—*Fine* sand from the knoll.

Sp. 10.—*Sharp* sand from the knoll, grains larger.

The following sketches, taken on the spot, will serve to shew the general structure presented by the remainder of this section. The lines express the larger features, parallel to which the filmy aggregation of the materials is arranged. Some of the pebbles are enveloped in a thin calcareous crust, attaching those contiguous.

Fig. 3. Near centre of section.

a, Soil.
b, Small gravel and ochre; brown earth.
c, Sand; alternate layers, ferruginous.
d, Small clean gravel.
e, Sand and clayey sand.
f, Large gravel.

g, Clean small sand.
h, Large gravel.
i, Sharp large-grained sand. Sp. No. 10.
k, Sand and clayey sand-belts.
l, Clean small gravel.

Fig. 4. To right of preceding, at transition into tilly earth.

a, *a*, Sand.
b, Gravel.
c, Gravel.
d, Gravel.

Fig. 5. To right of preceding.

a, Sand and gravel.
b, *b*, Gravel and sand.
c, *c*, Sharp sand.
d, Fine sand.

Eastward from this point there are similar knolls of gravel, on both sides of the Edinburgh road, for some miles beyond Falkirk: Likewise on the opposite margin of the valley, along the foot of the Ochil Hills.

Sp. 11. & 12.—The sand-pits of Carron Company are of considerable dimensions. The following is a sketch of pit west of Carron-House, depth 10 feet.

Fig. 6.

a, Small gravel and sand, with coal, grains size of a pea to an inch.
b, Sp. No. 11.
c, Sp. No. 12.

To the west it passes into fine blue clay; which again passes into dark-blue *till*, a compact gravelly clay, described in the paper already referred to. North of Carron-House is a large pit; the upper stratum contains semicircular curved lines; open side uppermost; diameter 5 feet, pass-

ing into small gravel-cover. The scarp of the ridge, formed by these knolls, fronts S. This sand-ridge, reposing on impervious *till*, is traversed by oozing hollows, in which some peat-earth has been formed, and is accumulating, from decay of moss-plants. Its recesses assume the form of small bays, one of which contains the Carron Foundry's reservoir. No shifts nor traversing veins have been remarked, and the layers are nearly horizontal.

At Spittalcroft, on the south side of Stirling, there is an extensive sand-pit. The same kind of sand extends to the greenstone rock at the town-walls.

Sp. 13. from gravel cover.

Sp. 14. sand immediately under. Like those already noticed, this sand contains granular coal, and exhibits shifts at veins traversing the layers. The matters of which it is composed serve to shew its relations. Its predominant colour is reddish-brown.

Sands and Gravels of the Upper District of the Forth.

Sp. 15. Above the village of Doune, the gravel exhibits calcareous incrustations. At Ashmill Bridge, south of Teath Bridge, a small knoll presents all the general features of the sand-hills of Edinburgh. Depth of section 8 feet.

Sp. 16. Small-gravel cover, mixed with ochreous earth.

Sp. 17. Clean gravel and sand under the cover.

Sp. 18. Sharp large-grained sand.

Sp. 19. Finer under it.

Sp. 20. Very fine from bottom of section. All these are separated by well-defined lines of contact, and are not hori-

zontal nor parallel. The sand under the gravel *cover* exhibits the counterpart of those peculiar wavy horizontal lines remarked in corresponding situations in the Edinburgh pits. A mile farther, on the banks of the Teath, and 20 to 30 feet above its surface, the sand occurs similarly arranged. Here the river flows rapidly over red sandstone.

Sp. 21. A little east of Ashmill, at Merlin's Ford, in Blair-Drummond policy, a bank of fine micaceous sand skirts the valley. The small-gravel cover under the vegetable mould is of several feet. It passes in sundry places into the subjacent sand betwixt two traversing veins, the section presenting the trumpet-form, mouth upwards. Minute shifts are common, at traversing veins. The general form is *knolled*. It reposes on red till, and the traversing hollows are spongy. The common dip is SW., being contrary to the surface in that direction, which rises into considerable swells of red till, reposing on red sandstone.

Twenty feet lower, is an oblong level field of 100 acres, with a slight declination to SW. On the N. is a steep scarp, 20 to 30 feet, the substratum gravel, composed chiefly of spheroidal sandstone, sometimes united by a black or pitchy base. This substratum transmits much water in spring. At the upper extremity of this field, the gravel terminates betwixt two ridges of old red sandstone, covered with red till, clayey earth, sand, and small gravel. Its opposite extremity passes under the carse-clay. The river Teath here forms the north boundary of a tongue of higher land, terminating at Blair-Drummond; the southern bank, stretching westward on the margin of the carse-clay, is composed of *till*, high and precipitous, surmounted with small-grained micaceous sand, many yards in depth, passing on the north into siliceous sand and gravel, exhibiting the common forms of arrangement. (This bank thus forms the counterpart of the one which passes by Merlin's Ford). Three or four

miles farther west, the quarries of old red sandstone on the margin of the valley shew, reposing on the rock, fine sand with the usual *regular forms*; over which, under the soil, a few feet of wafer-like scales of the sandstone, with sand intermixed.

In general, it may be remarked, that the granular coal, bituminous shale, and other products of the coal-formation, do not appear among the sands and gravels of this upper district, which have now been described. But the specimens manifest the presence of sundry pebbles of the transition-rocks; also of mica-slate.

Old Red Sandstone of Upper District of the Forth.

This appears, on its lower boundary, at Airthrey Mines, Bridge of Allan, Cruives of Craigforth, Dripfarm, and Redhall. It also forms Naad Knowe, a conical knoll, elevated above the Carse. The common dip and direction of the sandstone at all these points corresponds with that exhibited in the channel of the Teath and the Allan. This rock appears also within a few yards of Craig-forth, a mass of greenstone, which, rising through the Carse, presents, on one side, a perpendicular precipice. Here the sandstone is traversed by veins of greenstone, which may be seen in the bed of the Forth, and on the north side they were several yards in thickness, in the quarries for the roads. These last veins were of several yards in thickness.

The writer of the article *Perthshire*, in the Edinburgh Encyclopædia, states his opinion, that the Transition red sandstone is bounded on the south by the Ochil and Campsie Hills. I have marked on the map what appears to be its course on the south. From Redhall, in the direction of

Kippen, the red sandstone stretches along the north front of the Campsie Hills, commonly called Gargunnock Hills. At Boquhan, it is traversed by a torrent of that name, at a natural ravine, cutting it obliquely to a considerable depth. (Similar sections at Leckie and Gargunnock.) This red sandstone, like that on the north side of the valley, is covered by red till or tilly earth, with dip and direction also conformable. It presents a precipitous front to N, and the rivulet exhibits the succession of strata betwixt it and the perpendicular front of the Campsie Hills, over which it is precipitated at Balloch Leam. The rocks of the intervening hollow are conformable to the sandstone, of varied characters, and alternating until they reach the foot of the mural precipice of greenstone, which is rudely columnar. They are traversed by *veins* of greenstone connected with this stratum of greenstone.

Sp. 22. is from these strata. I was therefore led to the conclusion, that this red sandstone is a continuation of that on the north side of the valley,—that it passes *under* the Campsie range, at a small dip,—that the superincumbent strata accompany it,—and that, in place of the Campsie Hills reposing on coal (as supposed by Colonel Imrie), *that* substance will only be found recumbent on their southern and eastern extremities. The diagram, Fig. 7. will assist the description.

a, North front of Campsie Hills *.

b, Subordinate parallel strata.

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* The view from the north side of these hills is singularly beautiful. Rising perpendicularly, the valley appears as beneath the feet; beyond which its wide margin (*braes*) appear expanded and converging, studded with the seats of landholders, and strewn with farm-steads, as far as the eye can distinguish; the cultivated uplands extending northwards till they meet

pressed in that direction. Some are placed obliquely, and are, in like manner, flattened. Their surfaces are smooth and glossy. Longitudinally, they are somewhat tough; and, under their black hue, a tinge of greenish-yellow may be perceived. Many of these fragments include joints, from one extremity of which, frequently, slender roots extend; which marks them, according to my apprehension, as being the same with one of the aquatic reeds common in the district, which sends out roots in a similar manner from the lower joints. Fragments of small branches and twigs of birch are also apparent,—of the last, the cortical and medullary portions only remaining; also alder, or perhaps poplar, and thicker portions of another, soft and destitute of bark, resembling the roots of furze. Small, vesicular, flat, oval, greyish seeds, have been detected,—with others of same form, black, attenuated, and opened; considered by botanists to belong to the genus *Pedicularis*. A specimen of the stratum is herewith sent, and also of the superincumbent clay, with moss, from the lowest layer of Blair-Drummond, and of the common superficial moss of the valley. (Sp. 24, 25, and 26.) In superficial mosses, the lowest layer is most decomposed, more compact, and of a deeper black. The imbedded bones emit a strong odour by heat, as of rancid fish-oil. The stratum of black spongy earth on which the bones reposed, dips gently towards the east; and, in this particular also, agrees with the stratum at Fall-in. No trace nor odour of the contiguous clay is discernible. A few hundred yards to the west, it crops out; and, till lately, formed an obstruction to cultivation, after the superficial moss which covered it had been removed; but it has been rendered arable by a judicious use of *wedge*-drains, adapted to afford an exit for the water which proceeds from the substratum of sandy clay. The tenant remarked, that all this last is *jointed* like a rock, and

transmits water upwards through the seams. The rock-like structure of this substratum corresponds with what was remarked at Fall-in; and the specimens from that quarter exhibit a similar redundance of sand. It also corresponds with what appears at every deeper section of this extensive clay-field, which probably all reposes on sand and small gravel.

At this point, the surface of the clay declines towards its margin. The same has been frequently remarked along all the verge of the Carse districts, and is particularly apparent where the form of the adjacent rising grounds presents the resemblance of small bays on the margin of the valley. In these the clay-soil is observed to be of a superior quality, for agricultural purposes.

ALLAN-PARK, STIRLING,
15*th October* 1824.

XXV.—*Notice regarding Fossil Bones of a Whale discovered in the District of Monteith.*

By H. H. Drummond, Esq. of Blair-Drummond.

(*Read 4th December* 1824.)

In October 1824, the remains of a whale were found in the barony of Burnbank, which forms part of the estate of Blair-Drummond, at a place about three-fourths of a mile distant from the parish-church of Kincardine, in Monteith, and nearly a mile from the present course of the river Forth. The ground where the bones were found had been originally covered with peat-moss, which was a good many years ago floated into the Forth, in the course of the improvements of that nature which have been so successfully and so extensively practised on that estate. The soil under this moss, is what is very well known by the description of Carse-clay, and it was in digging a ditch in the clay that the bones were found. The clay at this place is only four feet deep, as it is near the outer edge of the carse-land where it approaches the surrounding banks, which, in the language of the country, are all termed "dryfield," of whatever description of soil they may consist, in contradis-

tinction to the carse-land, which, from its flatness and retentive quality, is naturally wet and swampy, until drained, for the purposes of agriculture. In general, as the carse-land recedes from the Forth, and approaches the dryfield, the stratum of clay becomes gradually thinner; and in many places a stratum of moss comes to the surface, near the margin of the dryfield, which dips under the clay towards the Forth. It was upon the surface of this second and lower stratum of moss, below the clay, that the bones were found. They were embedded in the clay, and did not penetrate at all into the moss below.

The bones found, and which are now deposited in the Museum of the College of Edinburgh, consist principally of a large portion of the cranium, comprising the occipital bone and foramen, frontal, a part of the superior maxillary, &c. There were also a scapula and several vertebræ, though in a mutilated state.

It is a very singular circumstance that, along with these bones, there should have been found a fragment of a stag's horn, similar to that found along with the Airthrey whale, and having a similar round hole bored through it. This piece of horn is also deposited in the Museum. A specimen of the stratum of peat-moss under the clay has been sent to the Museum, along with the bones in which the remains of wood, particularly alder, and of various water-plants, will be distinctly seen. The stratum was found to be six feet deep, and under it bluish sand was found, with little or no admixture of clay.

XXVI.—Tentamen Methodi Muscorum;

OR,

A New Arrangement of the Genera of Mosses, with Characters, and Observations on their Distribution, History, and Structure.

By R. K. Greville, LL.D. F.R.S.E. M.W.S. &c.,
AND
G. A. Walker Arnott, Esq. A.M. F.R.S.E.

(Continued from p. 89.)

(*Read 22d January* 1825.)

Memoir III.

Splachnoideæ, *Gen.* (11—13.)

Char. Calyptra mitræformis, basi thecam arcte cingens, mox dimidiata, lævis, glabra, tenerrima, fugax, basi integra. Seta terminalis. Theca apophysata. Operculum obtusum. Peristomium simplex; dentes varie geminantes. Columella apice dilatato-globosa.

Char. Calyptra mitriform, closely embracing the theca, at length dimidiate, even in surface, smooth, thin, evanescent, entire at the base. Seta terminal. Theca with an apophysis. Operculum obtuse. Peristome simple; the teeth variously geminating. Columella capitate.

Obs. So strongly and so conspicuously do the individuals composing this well-marked group resemble each other, not only in external habit, but also, for the most part, in intimate structure, that it is extremely difficult to establish genera, or subgenera, referable to it, upon well-grounded characters. Various ones have been proposed by the most eminent botanists, as, in the progress of their examinations, they have detected different situations, arrangements or directions, of the teeth of the peristome, or some other apparent peculiarity connected with the fructification. Thus we have *Aplodon** of Brown, in the Appendix to Parry's first voyage; also *Cyrtodon*† of the same author, proposed in the observations under *Aplodon* in the same work; both of which are removed from *Splachnum*. Mr Brown has also suggested that *Splachnum Frœlichianum* and *S. Wulfenianum* might with propriety form a subgenus, on account of their inclined capsule and erect teeth.

In the present paper we have carefully examined almost every recorded species and variety in the Order; and though we do not pretend to any original discovery, we have endeavoured, by generalizing our observations upon well-grounded data, to establish our genera on what we conceive to be more tenable, and even more natural, characters. The whole has been done under the highest respect for the talents of those able botanists and philosophers who have conferred additional importance on muscology, by devoting their time and knowledge to its illustration.

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* This genus was formed to receive a single species, the *Splachnum Wormskioldii* of Hornemann.

† This genus is composed only of *Weissia Splachnoides* of Thunberg and of Schwægrichen.

It is necessary to state, that our views respecting the *structure* of the peristome are essentially the same as those which Mr Brown has so admirably detailed in the twelfth volume of the Linnean Transactions, p. 577, *et seq.* That excellent muscologist has there expressed his opinion, that the semi-pellucid lines, or longitudinal striæ, at least denote a "tendency to division in the teeth where they are found." He also considers the prevailing number of teeth in the outer peristome of mosses to be thirty-two; "though, by a coalescence, more or less complete, they are frequently reduced to sixteen, in some cases to eight, and in a few even to four."

"According to this view," continues the same learned author, "a single longitudinal line in the axis of a tooth, indicates the confluence of two teeth; three equidistant lines, one being central, the coalescence of four; and seven lines, similarly disposed, that of eight."

"Nearly the whole of these modifications exist in that natural subdivision of the order, which may be named *Splachneæ*, consisting of *Splachnum*, *Systylium*, *Tayloria*, *Splachnum squarrosum* * of Hooker, and *Weissia Splachnoides*."

"The number of teeth in *Splachneæ* is thirty-two; which, however, are never entirely distinct, and at the same

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* This plant has been subsequently published, and figured, by Dr Hooker, as *Octoblepharum serratum*. However, from the calyptra of *O. albidum* being dimidiate, it must now retain the name of *Orthodon*, given to the genus by Bory de St Vincent. Mr Brown has drawn up its generic character in Linn. Trans. vol. 12. p. 597.

As we have had occasion to notice this species here, we may take the opportunity to mention, that we do not conceive it to belong very satisfactorily to the *Splachnoideæ*, and therefore we shall defer what we have to say concerning it to a future memoir.

time equidistant, but approximated or united in various degrees in the different genera and species of the section."

As it is most desirable in every science, and especially in that of muscology, to have the technical terms well defined, and their meaning limited to their respective objects, we shall here explain what we hold to be signified by the terms, *dentes geminati*, *dentes geminantes*, *dentes fissi*, and *dentes per paria approximati* *.

The *dens geminatus* is a tooth which appears to be a single one, but which is marked by a longitudinal semi-pellucid line, denoting a tendency to separation, and often actually producing a separation; the line must therefore extend from the apex to the very base, and might be called with propriety the *linea separabilis*. There are thus actually two teeth, which, when united, are called a once-*geminate* tooth, and, when separated, two *geminating* teeth.

The *dentes geminantes* are a greater or less number of teeth longitudinally coalescing, the number of teeth so united being shown by the semi-pellucid longitudinal striæ. The whole is called a tooth, which is farther characterised by being once, or twice, or four times, geminated.

The *dens fissus* is not provided with a *linea separabilis*;

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* From the confusion that has been created in consequence of the want of a general understanding on this point, the reader will readily concur in the necessity of a reformation of terms. The uncertainty of the present nomenclature may be exemplified in a few words. Hedwig, Schwægrichen, and others, describe the teeth of a *Splachnum* as "8-*geminati*." Bridel, at first, as "8-*paria*," and afterwards (as in *S. Magellanicum*) "16-*geminati*." While several authors apply "*dentes geminati*" to *Splachnum*, they use the phrase "*sedecem paria*" to *Systylium*, and "16 *per paria approximati*" to *Zygodon* and *Orthotrichum*, the structure of the teeth in all being the same. At the same time, also, "16 *paria*," or "16 *per paria approximati*," are attributed to *Didymodon*, *Trichostomum*, and *Leucodon*, genera having a peristome of a totally different nature.

it is a single tooth, cleft or divided more or less from the apex downwards, sometimes even nearly to the base; but at whatever point the division stops, there is no line visible below that point, by which the separation could be continued. The *dens fissus* is often perforated in such a manner, as to prove, that, in many instances, the division is the result of a series of lacunæ. A *dens fissus* should be considered as unity; a *dens geminatus* as a compound. The latter might be called *dens separabilis*, or *dens fissilis*; the former simply *dens fissus*.

The *dentes per paria approximati* are at no period of their growth longitudinally united; they are understood to be always separate, although not equidistant. Thus they must not be confounded with the *dens geminatus*, which is often divided to the very base by the *linea separabilis*.

To illustrate this a little farther, we will take a peristome of a Splachnum for examination; and suppose (as often takes place) that two or four of the thirty-two primary teeth are united by longitudinal cohesion. These teeth we would term *uni-* or *bi-geminantes*; and the tooth formed by this gemination, *uni-* or *bi-geminatus*. In several genera, as *Splachnum*, *Orthotrichum*, &c. this structure of the teeth forms a leading character *.

* We are aware, that, in the present state of muscology, we are liable to censure for the introduction of new terms and definitions, and the more so, that it is extremely difficult to define our ideas in express words. Thus several mosses are represented as having a longitudinal line down the middle of their teeth, and yet we have several reasons for doubting if they be really geminated; though a geminated tooth may be only partially divided, and is marked by a line, still we do not intend to assert, in every case where such a line is figured, that the tooth is geminated. It is therefore to be much wished that such as make drawings of the peristomes of mosses, would pay particular attention to this point.

When the *dens fissus* is cleft to the base, or nearly so, it becomes difficult to distinguish it from two teeth *per paria approximati*; and it is not improbable that the latter are, in some instances, nothing more than *dentes fissi*; but little or no confusion can arise from using two names to denote different states of the same structure.

Weber and Mohr (Handbuch, p. 10.) have some observations under Splachnum, much to our purpose. "Hujus et Orthotrichorum quorundam dentes non tam per paria approximati, sed principio adglutinati observantur. Posthac, imprimis si dentes reflectantur, nexus inter geminos tollitur, et tum primum 16 distinctos reperis. Hæc dentium cohæsione et in sicco statu reflexilitate maximopere jam hi musci a Didymodontibus peristomio semi-completo gaudentibus, quorum e numero in nostra Flora est *inclinatum*, discrepant, quippe quibus dentes ab initio omnes inter se liberi sunt, et nunquam reflexi. Quare *Splachnorum* et horum *Orthotrichorum* dentes 8 geminati, *Didymodontium* per paria approximati dicuntur."

We have now, finally, to remark, that, in our opinion, it will always be found, when a gemination of the teeth actually takes place, that the peristome, in the young state, forms one uniform undivided, but longitudinally striated, submembranous substance *, which is usually arched over the orifice of the theca; the tendency to split into a definite number of teeth being afterwards developed and regulated by the laws of nature. This idea appears to be corroborated by the fact, that, in the same tuft of specimens, we have repeatedly observed peristomes with six, eight, or twelve teeth,

* This structure, which we attribute both to the *Splachnoidea* and *Orthotrichoidea*, will certainly exclude from these orders any of the other species to which some have attributed a geminating line down the teeth.

and this in several species of *Splachnum*; the longitudinal lines, however, invariably denoting the total number of teeth to be thirty-two.

The *Splachnoideæ* differ from the *Orthotrichoideæ* by the capitate columella, by their scariose and fugacious calyptra, which is moreover without furrows, and closely adapted to the theca, until it splits longitudinally, and falls off; the base also is not lacerated. In the *Orthotrichoideæ*, the calyptra is permanently mitriform, loose about the theca, generally furrowed, and pilose; or, if glabrous, it is either laciniated at the base, or with four or five large triangular appendages.

Gen. XI. Splachnum, *Montin. Linn. Hedw.*

Fruct. *Calyptra* primo mitriformis postea succrescenda theca latere rumpens seu dimidiata, albida vel fuscescens, scariosa, tenera, lævis, glabra, valde fugax. *Seta* terminalis, lævis, plerumque rigida et stricta, quandoque autem tenera, succulenta, pallida; longitudine valde varians sed perichætio semper longior, sæpius solitaria, in una specie aggregata. *Apophysis* matura colorata, vel theca subæqualis vel amplior; obconica cylindrica aut globosa, aut etiam umbraculiformis; plerumque lævis quandoque rugosa, glabra. *Theca* integra, subcylindrica, apophysi brevior, semper estriata, ore absque annulo elastico. *Operculum* deciduum, thecæ subconcolor, obtusum, vel conicum vel hemisphæricum umbonatumque. *Peristomium* simplex e dentibus geminantibus siccitate arcte reflexis constans: dentes primarii (quousque nobis observare licet) 32, ma-

dore æquidistantes, in membranam cupulatam quasi, incurvi, uni- vel bi- vel quadri-geminantes transversim striati; horum geminati siccitate interdum æquidistantes, plerumque per paria quasi approximati. *Columella* exsiccatione plerumque exserta, stricta, rigida, apicem versus dilatata obtusa vel membranæ opercularis rigiditate acuta. *Sporulæ* griseæ, minutæ, globosæ, pellucidæ.

CHAR. DIFF. *Seta terminalis. Theca apophysata. Peristomium simplex e dentibus geminantibus siccitate arcte reflexis. Columella apice dilatata. Calyptra lævis, basi integra, fugax.*

FRUCT. *Calyptra* at first mitriform, at length, from the enlargement of the capsule, bursting on one side, or dimidiate, whitish or brownish, scariose, tender, even, glabrous, very fugacious. *Fruit-stalk* terminal, smooth, mostly rigid and straight, sometimes flexible, succulent, pale; in length varying extremely, but always longer than the perichætium, generally solitary, being aggregated in one species only. *Apophysis* coloured, when mature either about equal to the capsule in diameter, or larger, obconical, cylindrical or globose, or even umbraculiform, glabrous, mostly even, very rarely rugose. *Theca* entire, subcylindrical, shorter than the apophysis, never striated, the mouth destitute of an elastic ring. *Lid* deciduous, nearly of the same colour as the theca, obtuse, either conical or hemispherical and umbonate. *Peristome* simple, composed of geminating teeth, closely reflexed when dry: the primary teeth (as far as our observations have enabled us to decide) are thirty-two in number, and, when in a moist state, equidistant, but so close as to form, as it were, a cupulate membrane over the mouth of the theca; transversely striated, 1- or 2- or 4-geminating: the geminations sometimes equidistant when

dry, but mostly approximated, as it were, in pairs. *Columella*, in the dry state, mostly exserted, straight, rigid, dilated at the apex, obtuse, or, from the rigidity of the opercular membrane, acute. *Sporules* grey, minute, globose, pellucid.

DIFF. CHAR. *Fruit-stalk terminal. Theca with an apophysis. Peristome simple, of geminating teeth closely reflexed when dry. Columella dilated at the apex. Calyptra even, entire at the base, fugacious.*

VEG. The stems vary much in length, and are generally simple, rather slender, sometimes succulent, always erect. The leaves are inserted on all sides, more or less numerous, vasculose, diaphanous, the reticulation extremely lax; in form they have a range from lanceolate-acuminate to broadly ovate: they are also serrated, or entire, usually acute, but in *S. vasculosum* obtuse: all are furnished with a single nerve, disappearing before it reaches the point. The perichætial leaves scarcely differ from the cauline ones, except in being somewhat more attenuated.

OBS. We have already stated, in our observations on the present group, how nearly related are all the genera contained in it. Nevertheless there are no mosses (the Orthotricheideæ alone excepted) which vary so much in the apparent configuration of the peristome, or rather, in the combinations of its primary parts, when in the dry state. When moist, on the contrary, there are no mosses, the peristomes of which so remarkably resemble each other. In this state, all the teeth are united, as it were, into one mass, usually arched over the orifice of the theca, and divided longitudinally by a definite number of equidistant striæ, by means of which, it is easy, in almost every instance, to

calculate that the total number of teeth is thirty-two: but it is very difficult, if not impossible, to say where the separations are to commence, or how many are actually to take place. This is remarkably illustrated in *S. sphæricum*, in which the line down each geminated tooth, or the *linea separabilis*, appears as strong as that by which actual separation is produced. This structure sufficiently accounts for the different combinations observable in the teeth of the peristome, not only in the different species, but even in the same species. As few, or indeed any, plates exist which give a correct representation of the peristomes of the *Splachna*, and as most descriptions are equally erroneous (or at least only partially correct), we subjoin the result of our own extended observations.

1. *S. ampullaceum.* In this species the teeth are, in some specimens, 16 unigeminated, and geminating in pairs: in others (and more usually) 8, equidistant, bigeminated.
2. *S. vasculosum* presents the same variation. HEDWIG's figure of both species is incorrect. That of the present one, extremely so, except in the leaves.
3. *S. sphæricum.* This varies more than any other in the combinations of the teeth. There are in general 8, equidistant, either entire or slit down to the middle, and each of the divisions marked with a semipellucid line. Sometimes there are only 4, equidistant, each made up of 8 parts. In other specimens, again, there are 16 teeth, in the dry state, geminating in pairs, each with a longitudinal semipellucid line.
4. *S. Wormskioldii.* Peristome more regular; consisting, according to BROWN's observations and our own, of 16 equidistant unigeminated teeth. The

original figure of this plant, in "Flora Danica," represents them as placed in pairs.

5. *S. tenue.* In very recent specimens there appear to be 8 equidistant, bigeminated teeth; but the process of drying (without pressure) produces a division into 16, geminating in pairs, each with a longitudinal line, denoting simple gemination; this line is somewhat obscure, from the thick substance, and consequent greater opacity, of the teeth. The figures in Weber and Mohr, Tasch, t. 7. f. 2., and in "English Botany," t. 1133, are correct.

6. *S. octoblepharum.* From Dr Hooker's figure and description in "Musci Exotici," there exists in this species the proper number of primary teeth. They are, however, permanently compounded into 8, each of which is marked by three longitudinal lines. Our own specimens have lost their peristomes; but from Brown (in the Appendix to Parry's first Voyage, p. ccc) placing it in the genus *Splachnum*, "dentibus reflexilibus," we are inclined to do the same, as that gentleman, the discoverer of the species, must have had more numerous opportunities of examination than any other. We suspect our friend Dr Hooker has inadvertently transposed the words *siccitate* and *madore*, in describing the teeth; "siccitate (madore?) incurvis, madore (siccitate?) erectis vel etiam reflexis."

7. *S. Magellanicum.* Of this plant, Bridel says it possesses 16 geminate teeth; but from his remaining description, we suspect he intended 16 geminating, or, in other words, 8 geminated ones. We have ascertained that there are 16, resulting from the 8 teeth having divided: they are geminating in pairs, each tooth having a longitudinal line, which seems

to have escaped the penetrating eye of Mr Brown. (Parry's First Voyage, Append.)

8. *S. mnioides.* In native specimens of this species we have had no difficulty in observing either 8 equidistant bigeminate teeth, or 16 unigeminate ones, geminating in pairs. In specimens which we regard as belonging to this species, brought from the Arctic regions by Captain Parry, the teeth are extremely pellucid, and the line down each of the 16 teeth either very faint or invisible. None of the published figures of the peristomes are correct.

9. *S. urceolatum.* Hedwig, and also Sturm in "Deutschlands Flora," figure a peristome of 8 once geminated teeth. In "Flora Danica," t. 1361, there are represented 16 single equidistant teeth. We have found 8 equidistant, marked with 3 lines, at none of which have we observed any ultimate separation.

10. *S. angustatum.* Brown, in Parry's Voyage (Appendix), has observed the peristome to consist of 4 bigeminate teeth. We have also seen it of 4 teeth, but in our specimens they are satisfactorily quadrigeminate. We find it, however, still more frequently of 16 unigeminated, the line more obscure than in many other species.

11. *S. luteum.* Teeth 16, unigeminated, and so closely geminating in pairs as often to appear like 8 equidistant bigeminated ones. The only good representation of the peristome is in Schwægrichen's figure of *S. melanocaulon* (Suppl. 2.), which we do not consider different.

12. *S. rubrum.* Peristome in every respect similar to the preceding.

From the above detail of facts and remarks, it appears,

1*st*, That every *Splachnum*, according to our view of the genus, has 32 primary teeth, placed in twos, in fours, or in eights, (or even sometimes irregularly). In this place we must notice the four additional species constituted by Brown, in the Appendix to Parry's first Voyage, to all of which that profound botanist attributes 16 teeth for the primary number. We cannot confirm this, as we do not possess authenticated specimens of any of them; but conceive so remarkable an exception should be very cautiously admitted into physiological reasoning. That 16 teeth, however, were only visible in the peristomes examined by Mr Brown, is a fact not to be questioned on his authority.

2*dly*, With the exception of *S. Wormskioldii*, whenever the teeth present the appearance of being 16 once geminated, they are also placed in pairs, though not equally so in every species, for we have observed them almost equidistant in specimens of *S. sphærieum*; and Mr Brown also mentions, that, in *S. longicollum* of Dickson (a plant of North America), the teeth are "vix manifeste per paria approximati." In *S. Wormskioldii* these teeth are equidistant, the main character, we apprehend, on which Mr Brown has founded his genus *Aplodon*.

It should be recollected, however, that the 16 teeth of *S. Wormskioldii* are each composed of two united ones; or, in other words, they are geminate. We candidly confess, that those species which have 8 equidistant teeth, appear to us equally deserving of generic distinction, seeing that they are equidistant, though fewer in number, and composed of the same primary parts, each tooth being bigeminate. Taking, therefore, into consideration the great variety of combinations of these teeth, and the laws which the combinations seem to follow*, we have relinquished all

* The teeth are found to unite either in twos, in fours, or in eights. In *S. Wormskioldii* they are in twos.

hope of forming genera of the *Splachnoideæ* on characters thus derived.

From the remarks we have brought forward, it will be readily perceived that we can scarcely coincide with Mr Brown in his views regarding *S. Wormskioldii*. At first sight it bears a strong resemblance to *S. sphæricum*, so strong, indeed, that the indifferent, though original and authentic, specimens we received of the "Flora Danica" plant, we were at first tempted to consider as a mere variety of that species. Those brought home by Captain Parry proved them to be sufficiently distinct, the principal difference, however, seeming still to reside in the peristome. The fruit-stalk of *S. Wormskioldii* is certainly remarkably vasculose and succulent; but we have a very near approximation to the same structure in *S. sphæricum*, especially in that variety of it which has been called *gracile*. It is also seen in a somewhat less degree in *S. vasculosum*. In regard to the peristome, we have already shown that, in the moist state, there is no difference in the peristomes of any of the plants we have here brought together. When dry, it is true, the 16 geminated teeth of *S. Wormskioldii* are equidistant, though the other *Splachna* have them placed in pairs. Yet on this character Mr Brown has observed, "Transitus ab *Aplodonte* ad *Splachnum* facilis est per *S. longicollum*, cui dentes vix manifeste per paria approximati, qua nota differt à *S. tenue* valde affine sed dentibus geminatis reflexilibus instructo." When such intermediate gradations exist, we submit, with the utmost deference, whether it be not desirable to keep together plants so intimately united by structure as well as habit.

There is one point of difference between *S. Wormskioldii* and other *Splachna*, which we have omitted to notice. The *columella* is nearly simple, or not nearly so capitate as in the rest. This, however, is a subordinate distinction, and

of less importance, when we consider that there is almost every gradation from the broad and tabular termination of this part in *S. rubrum* and *luteum*, to the simpler one in *S. Wormskioldii*. We have, however, even in this last, seen it dilated at the apex; but they were rare instances.

In our character of the genus we have described the theca as subcylindrical. This is true in a general point of view, but in particular instances liable to variation. Thus, in *S. tenue*, it is occasionally oblong, or even subglobose: in *S. Wormskioldii* often contracted both at its orifice and base, and in the arctic North American specimens so as to be almost globose. The *apophysis* assumes various appearances, though nearly constant in each individual species. Its colour is almost always green in the young state, and as constantly changes in maturity. In *S. vasculosum* its surface is singularly rugose or undulated, a character altogether omitted in HEDWIG's figure (St. Crypt.), and even not sufficiently indicated in HOOKER's superior representation (in Musc. Brit.) This remarkable feature we have observed in another plant we have found on Ben Lawers, of which the plate of *S. rugosum*, in "English Botany" (t. 2094.), is so faithful and characteristic, that we have no doubt whatever in referring it to that species.

In most species the apophysis is of a sufficiently rigid nature to retain its form to the last. *S. rubrum* and *luteum*, however, are possessed of one so large, and, at the same time, of so delicate and membranaceous a structure, that it speedily becomes collapsed, and the base of the apophysis is brought into contact with the base of the capsule.

The sporular sac in the *Splachna* (and probably in all other genera, as already mentioned under *Diphyscium*) is, in the young state, supported by a pillar formed, as it were, by an internal continuation of the fruit-stalk. This must, in *Splachna*, pass, of course, through the apophysis, and is

correctly enough represented by HEDWIG in his figure of *S. ampullaceum* (St. Crypt. v. 2. f. 14.)

The calyptra in all our British species is whitish: in *S. Wormskioldii* of a brownish hue. As far as we have seen, it is truly mitriform in its young state, and becomes dimidiate only by the enlargement of the capsule, when it is almost immediately deciduous. Our excellent correspondent, Professor HORNSCHUCH, is of the same opinion, and even observes, "mehrere Splachna haben eine calyptra campanulata multifissa die en die C. dimidiata ubergeht*."

HAB. The *Splachna* are widely distributed throughout the alpine and the northern parts of Europe and North America. Species have been found also in the Straits of Magellan and in New Holland. Their places of growth are most remarkable, the greater number being found upon the dung of various animals. We ourselves have gathered *S. mnioides* attached to the long exposed bones of an ox. A friend of ours, who received the skull of a musk-ox, brought by Captain PARRY from Melville Island, discovered a luxuriant specimen of the same species (if we mistake not), lodged in the bones of the nose. Our esteemed friend Dr RICHARDSON mentions that he always found it in arctic America, enveloping with its roots the bones of some small animal †. But though most prefer some animal substance or other, there are exceptions; a few growing on the ground or in wet springy places, and one alone (*S. octoblepharum*) on the rotten trunks of trees.

HIST. The original *Splachnum*, or Σπλαγχνον, has been usually rendered in Latin by *viscus*, and it is no easy mat-

* HORNSCHUCH in Litt.

† RICHARDSON in FRANKLIN's Journal, Append. p. 755.

ter to perceive how DIOSCORIDES * and GALEN † could have applied it to mosses. DILLENIUS ‡, however, throws some light on this question, when he traces the plant of DIOSCORIDES to belong to the genus *Usnea*. Nevertheless, with all the want of connexion between it and the true mosses, we find that LAUR. MONTIN, in the second volume of the "Amœnitates Academicæ," p. 248, bestowed the name upon the present genus, with the following character: "Calyx calyptrata, operculata, receptaculo membranaceo, colorato, maximo, imposita." After which we have these remarks: "Genericis itaque characteribus propositis, nomen antiquum, *Splachnum*, hinc adjungam, mutatum a DIOSCORIDE, qui Muscis hoc imposuit. Nomen genericum characterem essentialem exprimens in promtu quidem me habuisse non erit diffitendum; sed, ne mori a botanicis recepto contrarius viderer, suadente etiam Fund. Bot. § 241. vagum illud certo generi præfigere volui. Origo hujus nominis omnino est Græca, a voce Σπλαγχνον, abjecta litera γ, suos ducat natales." We regret, however, that MONTIN did not adopt another name.

The species observed to be natives of Great Britain before the time of DILLENIUS, and represented by him, are, *S. ampullaceum*, *sphæricum*, and *nnioides*. A fourth, *S. rubrum*, from Lapland, is inserted in the Appendix. MONTIN, in the essay we have quoted, unites the three first, and adds *S. luteum* under the name of *flavum*. Since, then, other species have been described from time to time. HEDWIG, in his "Stirpes Cryptogamæ," has three species, not known to LINNÆUS, *S. Frœlichianum*, *urceolatum*, and

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* DIOSC. l. l. c. 20.

† GALEN, τῶν κατα τοπ. l. l. c. l.

‡ DILL. Hist. Musc. p. 240.

Brewerianum, and in the "Species Muscorum," the additional ones of *S. ovatum* and *serratum*; several of the above, however, we consider as mere varieties. SCHWAGRICHEN, in his first Supplement, enumerates in the whole fifteen species; of which, however, we regard *S. gracile* and *S. ovatum* as varieties of *S. sphæricum*, and *S. Brewerianum* as a variety of *S. nuicoides*. In his second Supplement, he has described *S. melanocaulon*, which is, in our opinion, merely a dwarf variety of *S. luteum*. Sir J. E. SMITH has still another species, in "English Botany," *S. rugosum* of DICKSON. We are ignorant whether this be really DICKSON's plant or not. The authors of "Muscologia Britannica" state, that, from an examination of DICKSON's own specimens, they refer it to *S. sphæricum*. Be all this as it may, we have assuredly found the plant so well represented in "English Botany," and consider it specifically distinct from *S. vasculosum*, to which it is nearly allied. DICKSON, who is the original authority for many species taken up by HEDWIG and SMITH, has described another species, about which much doubt has arisen: this is *S. longicollum*, a plant which has been referred by Doctors HOOKER and TAYLOR to *S. tenue*. BROWN, on the other hand, says that it has never been found in this country, "Americæ occidentali nec Scotiæ indigenum *," and that it is different from *S. tenue*.

We have now a few recent works to notice. Out of the seven species contained in the "Muscologia Britannica," we have referred *S. Frœlichianum* to the next genus (*Dissodon* nobis). In HOOKER's "Musci Exotici" are two species, *S. octoblepharum* and *S. scabrisetum*, the latter of which we also refer to *Dissodon*. HORNSCHUCH, in the

* PARRY's first Voyage, Append. p. ccxcix.

"Horæ Physicæ Berolenses," has figured the beautiful *S. Adamsonianum*, of which we have no authentic specimens. A plant has been recently communicated to us by Dr HOOKER, brought home by Captain PARRY in his second Expedition, and which is no way different from the Kamtschatka one: Dr HOOKER at the same time mentioned that he considered this identical with the *S. paradoxum* of BROWN. It appears a good species, intermediate between *S. tenue* and *mnioides*. We can scarcely presume to judge of *S. arcticum*, *propinquum*, and *exsertum*, of BROWN, in the Appendix to PARRY's first Voyage, as we have not specimens; but we cannot resist the suggestion that they may be different states of that polymorphous species *S. mnioides*,—nor do we even venture thus far, without having examined very many varieties of what we consider *S. mnioides*, presented to us by Mr EDWARDS, and other gentlemen who accompanied Captain PARRY on his *second* voyage.

After subtracting from the twenty-two species, described by BRIDEL, those which are mere varieties, and some species belonging to other genera, and adding to the remainder, *S. octoblepharum* (HOOK.), *S. Wormskioldii* (HORNEM.), *S. longicollum* (DICKS.), and *S. Adamsonianum* (HORNSCH.), we shall count sixteen well-established species *.

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* Of those we reject, *S. Wulfenianum* is *Orthotrichum Ludwigii* (SCHWÆGR.)—*S. Frœlichianum* we place under *Dissodon* (excluding, of course, *Gymnostomum Griffithianum*, confounded with it by BRIDEL and SWARTZ).—*S. lingulatum* is our *Dissodon splachnoides*.—*S. serratum* and *flagellare* are varieties of *S. tenue*.—*S. Brewerianum*, a variety of *S. mnioides*.—*S. setaceum*, certainly only a variety of *S. angustatum*.—*S. ovatum* and *gracile*, varieties of *S. sphæricum*.—*S. pusillum*, according to PALLISOT's Herbarium, is *S. vasculosum*.—*S. Turnerianum* does not differ from *S. ampullaceum*.—As to *S. Juressi*, we have not seen it, and know not what to make of it.

PLATE XIII

SPLACHNUM DISSODON TAYLORIA

wille del.

W. Miller scalp.

PLATE XIII.

Fig. 1. Theca of *Splachnum ampullaceum*. 2. The teeth, when 8, bigeminate. 3. Do., when 16, unigeminate.

4. Theca of *S. vasculosum*. 5. The teeth when bigeminate. 6. Do. when 16, unigeminate.

7. Upper leaf of *S. rugosum* (Eng. Bot.) 8. Lower do. 9. Sporules.

10. Thecæ of *S. sphæricum*. 11. One of the teeth when quadrigeminate. 12. One do. when bigeminate. 13. Teeth when 16, unigeminate. 14. Sporules. 15. Appearance of the fruit-stalk when highly magnified.

16. A dry theca of *S. Wormskioldii*. 17. A moist one. 18. The operculum. 19. The teeth. 20. The fruit-stalk highly magnified.

21. Theca of *S. tenue*. 22. Theca of do. in the dry state. 23. Calyptra of do. 24. Teeth when 16, unigeminate.

25. Theca, with the operculum, of *S. angustatum*. 26. One of the teeth when quadrigeminate. 27. Teeth when 16, unigeminate. 28. Sporules, which are larger than in the other species, and of a yellow colour. 29. Leaf.

30. Theca of *S. luteum*. 31. Teeth. 32. Summit of columella. 33. Structure of the apophysis highly magnified.

GEN. XII. DISSODON *nobis*.

FRUCT. *Calyptra* primo mitriformis, mox sæpius dimidiata, albida, scariosa, tenera, lævis, glabra, basi integra,

valde fugax. *Seta* terminalis, plerumque lævis (in una tamen scabra), rigida, sæpius breviuscula, stricta, quandoque elongata et subflexuosa, e luteo rubescens. *Apophysis* matura, obconica, thecæ paullo angustior et concolor, lævis. *Theca* integra, ovata, apophysi longitudine subæqualis, lævis, ore paullum contracto, absque annulo elastico. *Operculum* thecæ subconcolor, breve conicum, obtusum, in quibusdam speciebus interne columella adnatum et diu persistens. *Peristomium* simplex, e dentibus primarius 32, unigeminantibus, siccitate strictis, plus minusve erectis, nunquam reflexis constans: dentes geminati siccitate vel equidistantes vel per paria geminantes at madore ut in *Splachno*. *Columella* plus minusve exserta, stricta, rigida, apice dilatato-globosa. *Sporulæ* ut in *Splachno*.

CHAR. DIFF. *Seta terminalis. Theca apophysata. Peristomium simplex e dentibus geminantibus, siccitate erectis, strictis. Columella apice dilatata. Calyptra lævis, basi integra, fugax.*

FRUCT. *Calyptra* at first mitriform, at length mostly dimidiate, whitish, scariose, tender, even, glabrous, very fugacious. *Fruit-stalk* terminal, mostly even (in one species rough), rigid, generally rather short, straight, sometimes elongated, and subflexuose, yellowish or reddish. *Apophysis* when mature obconical, a little narrower than the theca, nearly the same colour, and smooth. *Theca* entire, ovate, about equal in length to the apophysis, even, slightly contracted at the mouth, and without an elastic ring. *Lid* nearly of the same colour as the capsule, shortly conical, obtuse; in some species, internally adnate with the columella, and remaining a considerable time. *Peristome* simple, of 32 primary, once geminating teeth; which, when dry, are straight, more or less erect, never reflexed: these

geminated teeth, when dry, are either equidistant, or geminating in pairs; when moist, they are the same as in *Splachnum*. *Columella* more or less exserted, straight, rigid, dilated in a globose manner at the summit. *Sporules* as in *Splachnum*.

DIFF. CHAR. *Fruit-stalk terminal. Capsule with an apophysis. Peristome simple, of geminating teeth, which when dry are erect and straight. Columella dilated at the apex. Calyptra even, entire at the base, fugacious.*

VEG. *Stems* forming dense tufts, erect, more or less elongated, nearly simple: (in our *D. Splachnoides* they often occur 2—3 inches in length, deeply imbedded in the ground). Leaves imbricated pretty closely on all sides of the stem, suberect or patent, especially towards the summit of the stem. They are all highly vasculose and reticulated, green when growing, but sometimes gaining a yellowish hue in drying. They are nearly uniform in shape, between ovate and lingulate, all remarkably rounded and obtuse at the extremity, and concave. There is no appearance of serratures, and the nerve in every instance disappears a little below the summit. The perichætial leaves do not differ from the rest, except in being perhaps more patent.

OBS. For the institution of this genus, as well as the alterations of the preceding one, we solicit the indulgence of muscologists,—at least till what we have advanced has been submitted to a fair examination. It may be urged against us that we rest too strongly upon the appearance of the peristome in a dry state. We do believe that, in this genus, the main generic distinctions are to be taken from the characters then exhibited. We have shown that, when moist, nearly all the peristomes of the *Splachnoideæ* have

a wonderful resemblance to each other; that, in short, no generic marks can then be collected from them.

When, on the other hand, we note the *direction* of the teeth in a dry state, and find that they constitute more obvious distinctive features;—that all those species which have reflexed teeth form a natural group, even to the acute form of the leaves (except in *S. vasculosum* alone);—that all those which have erect teeth* (not reflexed) agree still more beautifully in habit, their capsule of a different shape, their apophysis narrower than the capsule, and of the same colour, their leaves all agreeing most strikingly in their obtuse form and texture;—that, farther, when we see equally forcible characters taken from the direction of the teeth in the dry state of *Tayloria*, we cannot help flattering ourselves, that, for the tribe of mosses now under consideration, these are the only tangible generic characters. Those we have discarded seem only of importance, inasmuch as they indicate affinity and similarity of structure.

The peristome of *Dissodon* varies much in the same manner as that of *Splachnum*: 1*st*, In one species, the teeth are 16, once geminated, and equidistant; besides which, each tooth, when mature, is divided at the line of gemination, either to the middle or to the base. 2*dly*, In another species, the teeth, though 16, and also equidistant, remain permanently once geminated. 3*dly*, In the other species, they are 16 once geminated, and also geminating in pairs†.

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* Mr Brown seems to consider erect teeth as worthy to constitute a subgeneric character, and thinks *S. Frœlichianum* and *S. Wulfenianum* might be placed together on that account, joined to the inclined capsule.—Parry's First Voy. App. p. ccci.

† We have in our possession, through the kindness of our friend Dr Hooker, a plant which we consider to belong to this genus: but as it has only a manuscript name attached to it, we refrain from noticing it farther. It assimilates with the rest in every character.

Of the first mentioned of these we have the genus *Systylium* of HORNSCHUCH, on account of the teeth being rather short, erect, geminating in pairs, and the lid connate with the columella. Of the second, we have the genus *Cyrtodon* of BROWN, on account of the teeth being long and incurved at the apex. Of one of the last, Mr BROWN observes, "*Splachnum Frœlichianum* et forsan *S. Wulfenianum* *, capsula inclinata et dentibus erectis a Splachnis genuinis distinguitur, et subgenus efformat." Under *Aplodon*, the same author shows, nevertheless, how near his *Cyrtodon* is allied to *S. Frœlichianum:* "Diversa præsertim dentibus erectis apicibus incurvis, ideoque *S. Frœlichiano* dentibus erectis, sed geminatis affinis." Upon these principles, we fear, genera might be constituted of several more species of *Splachnum;* for instance, *Dissodon scabrisetum* (*Splachnum scabrisetum*, HOOK.) has the teeth involute in a remarkable degree, when moist †, and in this circumstance differing from all the rest; this is, we apprehend, as valid a generic character as some of the above,—but, at the same time, of as little consequence.

Of all the plants we have brought together under this genus, *Systylium* seems, at first sight, to have the greatest claims to be kept apart, and that, on account of the long persistent lid. We agree with BROWN, however, that this can scarcely form a generic character. Under *Aplodon*, he observes, "In hoc enim cohærentia operculi cum columella ex analogia cum Gymnostomis quibusdam, pro charactere specifici tantum valoris habenda sit" Besides, the lid eventually separates from the columella: but a stronger reason

* This plant is *Orthotrichum* Ludwigii.

† We do not mean to say that the teeth were involute before the operculum dropt off, but only after having been exposed to the action of the atmosphere.

still against its being retained as a generic character, is, that a similar circumstance exists, in a less degree, in recent specimens of *Dissodon Splachnoides* (*Weissia Splachnoides*, Auct.) The lid is here very frequently adnate with the columella for a considerable time, and is so represented both by Dr HOOKER in "Fl. Lond." and Dr GREVILLE in "Crypt. Fl.:" it is therefore at least exactly intermediate, in this respect, between HORNSCHUCH's *Systilium* and the rest of our *Dissodontes*.

Two very remarkable points, common to all our species, are, the ovate form of the theca, and the obconical apophysis: the latter tapering downwards from the base of the capsule, renders the shape of the whole more or less obovate, and affords a fructification very different, at first sight, from that of *Splachnum*; more especially when we take into consideration the equally remarkable fact, that, in *Splachnum*, the apophysis is coloured, whereas, in *Dissodon*, it is of the same colour as the capsule. Thus, not only in habit, but in every character of importance, do all the species of the latter genus agree.

HAB. We are not aware that any of the species are produced on any decomposing substances, as are most of the last genus. One is found among rocks; another in a firm, wet sward, intermixed with grass and other plants; a third in the crevices of rocks. As to the fourth, we do not certainly know on what it was found growing. Three are peculiar to the alpine parts of Europe. The other occurs in South America.

HIST. We have already mentioned that one of our species had previously constituted a genus under the name of *Systylium*, and that of another was formed *Cyrtodon*. As these names imply a peculiarity of structure not common

to all the plants we have brought together, we have been obliged to reject both, although, from respect to Mr Brown, and friendship for our correspondent Dr Hornschuch, we would gladly have avoided it, if possible. Had not the name *Orthodon* been preoccupied, it would have been precisely that we should have taken for the present genus; which we have denominated *Dissodon*, a word at least expressing a character common to all the species. The first known of our species was described and figured by Hedwig, and about the same time discovered in this country by Dickson on the Scottish alps. Dickson seems to have discovered the next, and published it as a *Splachnum*; but Swartz, almost immediately following, described it as a *Weissia*, the generic name of which it has retained ever since, till Brown gave it that of *Cyrtodon*. Of this plant, we may here remark, that, from the imperfection of the specimens existing in herbaria, no correct figure had been given till the year 1824, when both Dr Hooker and Dr Greville published ample analyses of the different parts. The geminated structure of each tooth was observed some years ago by Mr Arnott, in specimens procured from the Reverend Mr Macritchie of Clunie, and urged with several muscologists as a proof how incorrectly it had been allowed to remain in the genus *Weissia*. Mr Brown, however, has the first claim for the publication of this structure. To Dr Hornschuch we freely expressed our opinion that his *Systylium* could not be separated as a genus from the same plant. Along with additional specimens for examination, he obliged us, in return, with the following remarks: —"Ich night glaube dass es mit *Weissia Splachnoides* in ein genus vereinigt werden kann, da der Bau der Taehne gar zu bedeutentend abweicht, wie Ihnen die Untersuchung zeigen wird, auch ist die Verwachsung des operculi mit der Columella so standhaft und ausgezeichnet dass sie nach

meinen dafürhalten immer als Merkmaal bey Aufstellung des Gattungscharackters mit zu Hülfegenommen werden kann." We have examined the specimens he kindly sent to us, and regret to say we still cannot coincide with him on the importance of the characters which he draws from the peristome and columella, above alluded to. As we have united several genera in the formation of *Dissodon*, we conceive that characters of the species may not be unacceptable.

1. *Dissodon Splachnoides*; foliis patentibus, lingulatis, obtusis, concavis; peristomii dentibus 16 geminatis, integris, æquidistantibus apice incurvis; seta lævi.

Weissia *splachnoides*, Swartz. Schwægr. Suppl. 1. p. 63. t. 17.—Hook. et Tayl. Musc. Brit. t. 14. Fl. Lond. (New Series) t. 192.—Grev. Crypt. Fl. t. 145.—Funck Deutschl. Moose. t. 9.
Splachnum *lingulatum*, Dicks. Cr. fasc. 4. p. 4. t. 10. f. 6.—Smith, Engl. Bot. t. 2095.—Brid. Meth. p. 105.
Grimmia *splachnoides*, Smith, Engl. Bot. t. 2164. (excl. fig. fol., et synon. Dicks. ac Fl. Brit.)
Cyrtodon, Brown in Parry's First Voyage, Append. p. ccxcix.

Hab. Scotland, Germany, Lapland, etc.: in turf-bogs at a considerable elevation.

The 16 geminated teeth are of a yellow colour. The columella is often much exserted, and the lid frequently adnate with its apex.

2. *D. Hornschuchii*, foliis erectis, appressis, ovato-lingulatis, obtusis, concavis; peristomii dentibus 16 geminatis, per lineam separabilem solventibus, æquidistantibus, rectis: seta lævi.

Systylium *splachnoides*, Hornsch. in Comment. de Voit. et Syst. p. 14. t. 2.—Hook. Musc. Exot. t. 98.—Schwægr. Supp. 2. t. 107. Funck, Deutschl. Moose. t. 6.

Hab. On a micaceous rock in the Carinthian Alps.

The teeth are short, and bright red, and usually so deeply divided at the line of gemination as almost to present the

appearance of 32 teeth placed in pairs. The last species has the seta elongated: in the present one it is short and thick.

3. *D. Frœlichianum*, foliis erectis, appressis, ovato-lingulatis, obtusis, concavis; peristomii dentibus 16 geminatis et per paria geminantibus.

Splachnum *Frœlichianum*, Hedw. Stirps. Crypt. 3. p. 99. t. 40.—Schwægr. Suppl. 1. pt. 1, p. 51.—Brid. Meth. p. 105.—Schkukr, t. 18.—Sturm, Deutschl. Fl. fasc. 15.—Funck Deutschl. Moose. t. 7.

Splachnum *reticulatum*, Swartz. Smith Engl. Bot. t. 2507. (quoad folia mala).

Bryum *reticulatum*, Dicks. Cr. fasc. 2. p. 4. t. 4. f. 6.

Hab. Fissures of rocks in Switzerland, Germany, Scotland, and Sweden.

Many foreign botanists have, till lately, confounded this with *Gymnostomum Griffithianum*; a mistake which originated from the latter not having been seen by them.

4. *D. scabrisetum*, foliis subpatentibus, lingulatis, obtusis, subconcavis, dentibus 16 geminatis et per paria geminantibus, madore involutis; seta scabra.

Splachnum *scabrisetum*, Hook. Musc. Exot. t. 32.

Hab. Province of Jaen de Bracomoros, South America, at an altitude of about 6400 feet.

This species has the teeth erect when dry, at least in our specimens, received from Humboldt and Kunth. When moist, they are remarkably involute. The leaves are less concave than in the rest, and slightly undulated.

PLATE XIII.

Fig. 34. Capsule of *Dissodon Hornschuchii*, with the operculum. 35. Operculum, with a portion of the adnate columella. 36. Portion of the peristome. 37. Two of the geminate divided teeth, all united at the base. 38. Leaf.

39. Capsule of *D. splachnoides*, with the operculum. 40. The same dissected, and showing the columella adnate with the operculum. 41. Calyptra. 42. Three of the 16 geminate teeth, all united at the base. 43. Leaf. 44. Sporules.

45. Capsule of *D. Frœlichianum*, with the operculum. 46. Four of the 16 geminate teeth, all united at the base. 47. Leaf.

48. Capsule of *D. scabrisetum*, with the operculum. 49. Two of the involute (when moist) geminate teeth united at the base. 50. Leaf.

Gen. XIII. Tayloria, *Hooker*.

Fruct. *Calyptra* mitriformis, albida, scariosa, tenera, lævis, glabra, valde fugax. *Seta* terminalis, elongata, lævis, rigida, strictiuscula, aurantiaca. *Apophysis* matura obconica, theca longior et angustior, subconcolor, lævis. *Theca* integra, oblongo-cylindrica, lævis, pallide brunnea, ore rubescente. *Operculum* conico-elongatum, obtusum, theca subæqualis, paullo incurvum, concolor. *Peristomium* simplex e dentibus 32 unigeminantibus, infra marginem thecæ intus insertis, longissimis, attenuatis, rubris, transversim striatis; madore intra thecam involutis, siccitate, "erecti diffusi, halitu observantis tacti singuli spiraliter, sed laxe se contorquentes et rursus evolventes, semina dispergentes, continuo tremuli et mobiles, simili quodam motu ut fila, Equiseti germen cingentia," (Schwægr.) *Columella* valde exserta, stricta, rigida, globoso-capitata. *Sporulæ* . . . . . .

Char. Diff. *Seta terminalis. Theca apophysata. Peristomium simplex, e dentibus* 32 *geminantibus, longissi-*

mis, siccitate diffusis, tortuosis. Columella apice globoso-capitata. Calyptra lævis, fugax.

Fruct. *Calyptra* mitriform, white, scariose, tender, even, smooth, very fugacious. *Fruit-stalk* terminal, elongated, even, rigid, straight, of a reddish-orange colour. *Apophysis*, when mature, obconical, longer and narrower than the capsule, nearly of the same colour, even. *Theca* entire, oblong-cylindrical, even, pale brown, the mouth reddish. *Lid* conical, elongated, obtuse, nearly equal in length to the theca, and of the same colour, somewhat curved. *Peristome* simple, of 32 unigeminating teeth, very long, attenuated, transversely striated, inserted a little below the inner margin of the orifice: when moist they are highly involute, and concealed within the capsule: when dry, erect, diffuse, spirally twisting together in a lax manner under the influence of the moist breath or touch, and again becoming evolved, scattering the sporules, and preserving a constant tremulous motion, similar to that of the filaments which embrace the germen of the *Equiseti*. *Columella* much exserted, straight, rigid, globoso-capitate. *Sporules* . . . . . .

Diff. Char. *Fruit-stalk terminal. Capsule with an apophysis. Peristome simple, of 32 very long geminating teeth, which when dry are diffuse and tortuose. Columella globoso-capitate. Calyptra even, fugacious.*

Veg. Stems for the most part tufted, about an inch long, either simple, or branched with innovations, the lower parts covered with a ferruginous down. The lower leaves are smaller than the upper ones; the latter more closely arranged; they are all imbricated, green, erecto-patent, ovato-lanceolate, acute, with a serrated margin towards the

apex: their substance is tender, pellucid, loosely reticulated, as in the *Splachna*. The nerve disappears beneath the summit. The perichætial leaves are four or five in number, and are considerably smaller than the cauline ones.

Obs. No plant that has come under our observation has so great a resemblance to this species as *Splachnum tenue*: the likeness is indeed so strong, that, to the naked eye, there is no difference, except in the lid, which, if it be wanting, leaves the microscope alone to determine between the two. With the assistance of that instrument there is no difficulty, if the peristome be present.

Dr Hooker has figured this moss more correctly than any one else, and represented the approximation, or rather gemination, of the teeth with more truth than Schwægrichen. They are of a very fine red, most remarkably long, longer even than the theca itself; in the dry state they become reflexed, and tortuous in an extraordinary degree, contracting and expanding themselves with great rapidity on the application of the slightest degree of moisture or warmth. The fruit-stalk varies from one to two inches in length, and is smooth, solitary, erect, or slightly flexuose. The theca, when growing, is almost cylindrical, but in the process of drying often becomes nearly hemispherical *. The apophysis tapers so gradually downwards from the theca, that, being of the same colour, it seems at first sight a continuation of that part.

Hab. On wet rocks in Norway, Switzerland, the southern Tyrolese Alps, and the summits of the Carinthian mountains.

* This also takes place not unfrequently in *Splachnum tenue*.

Hist. Under this head we have little to say, there being only one species in the genus, and that one recently introduced to the notice of muscologists. We believe it to have been discovered by the lamented Professor Schmidt of Christiana, the same who accompanied Captain Tuckey in his expedition to the Congo river. We know not if he bestowed on it a name. In 1814, Dr Hooker found it on the *Grimsel*, close to the Glacier du Rhone, at an altitude of about 5000 feet; and he soon after constituted the present genus, in order to receive it, in Brande's Journal of Science and the Arts*. In the mean time, Schleicher and Seringe also gathered it in Switzerland, and transmitted specimens to Schwægrichen, under the manuscript name of *Hookeria*. Thus while Hooker dedicated it to his friend, and future coadjutor in the Muscologia Britannica, it was named on the Continent after himself;—a singular and interesting coincidence. It so happened that both names were made public in the same year (1816). *Tayloria*, however, had the precedence of some months; yet it is a strange circumstance that, till recently, it has been discarded by every continental botanist, and *Hookeria* substituted in its place, although that name was preoccupied by Sir J. E. Smith, in favour of another genus, also of mosses. We rejoice to find at length the justice of the claim of *Tayloria* acknowledged. Our friends Nees von Esenbeck and Hornschuch have taken up both it and *Hookeria* of Smith in their excellent "Bryologia Germanica;" and we are acquainted with no muscologists possessed of more liberal feelings, or who are so well able to establish both genera as firmly on the Continent, as they have long been in this country. Sprengel has also adopted

* No. 3. p. 146.

Hookeria *. It must be confessed, that, when our friend Professor SCHWÆGRICHEN thus expressed his opinion concerning SMITH's *Hookeria*, "Quam proposuit SMITHIUS in Actis Societatis Linnæanæ, v. 9. p. 272, Hookeria in systemate Hedwigiano genus proprium esse nequit," he should at least have left the field open, and the name otherwise unappropriated;—Sir J. E. SMITH being besides a warm supporter, and no less an able one of the Hedwigian school.

PLATE XIII.

Fig. 51. Capsule of *Tayloria*, with the operculum. 52. Summit of the capsule, shewing the exserted columella, and the teeth in the involute state, within the capsule. 53. Four of the 32 geminating teeth, as appearing in the dry state, when they are spreading from the orifice in all directions.

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* "Neue Entdeckungen," vol. 3.

XXVII.—*Notice in regard to the Trap Rocks in the Mountain Districts of the West and North-west of the Counties of York, Durham, Westmoreland, Cumberland, and Northumberland.*

By Henry Witham, Esq. of Lartington.

(*Read 3d May* 1824.)

THE various opinions which have been entertained at different periods respecting the origin of the Trap Formation, by the most distinguished geologists, gives a peculiar interest to its geognostical history, and confers on those districts where it occurs a high degree of importance. Some geologists, as is well known, maintain, that secondary trap rocks owe their origin to the action of subterranean heat; which power, it is alleged, was instrumental in giving them their mineralogical characters, and present position in the crust of the Earth. This immeasurable power, according to the igneous theory, forced them from their birthplace, very deep in the bowels of the earth—even under gneiss and mica-slate, through every variety of primitive and transition rock, to their present place in the formations of the secondary class. These secondary traps, then, if this explanation

is the true one, are placed deeper in the crust of the Earth than gneiss and other primitive rocks. But this Huttonian explanation is opposed, and with much ingenuity and force of argument, and detail of fact, by the Neptunians, who insist on the deposition of trap from aqueous solution and suspension. We do not pretend to advocate either opinion, but maintain, that these rival hypotheses have been eminently useful, and that, without their aid, geology would have long remained stationary. Can we believe those to be in earnest who assert, that opinions, which have been the means of calling into action the zeal and acuteness of such observers as HALL, JAMESON, and BUCKLAND, and which have afforded opportunities for splendid displays of the powers of HUTTON, WERNER, PLAYFAIR, and CUVIER, have been not only useless, but even pernicious?

On visiting the districts enumerated above, my attention was forcibly arrested by the phenomena exhibited by the trap-rocks, and it is of these I now propose to lay a notice before the Society. But as these are considered by geologists as forming part of the same general series with those of Derbyshire, we shall first mention shortly the Derbyshire stratification.

In the metalliferous strata of Derbyshire, it appears there are nine different alternations; namely, grit-rock 120 yards, limestone-shale 160 yards, first limestone-rock 50 yards, first toadstone or amygdaloid 20 yards, second limestone-rock 50 yards, second toadstone or amygdaloid 30 yards, fourth limestone-rock 130 yards; making a total thickness of 650 yards. Here we perceive the beds of metalliferous limestone are separated by beds of trap rocks, called Toadstone. When a vein of lead is worked through the first limestone down to the toadstone, it ceases to contain ore, and often entirely disappears. On sinking through the toadstone to the second limestone, the ore is again found, but cut off by a lower

bed of toadstone, under which it again appears in the third limestone. In a few instances strings and short branches of ore have been discovered, but the few veins which pass through this substance contain no ore. How to account for this unequalled stratified arrangement must require no small share of ingenuity. It has been maintained, that the toadstone and limestone, with the metallic veins of this district, are of contemporaneous formation, but the different organic remains in the upper and lower beds of limestone preclude the possibility of such simultaneous formation. CUVIER has very justly observed, that the existence of different organic remains, offers irresistible proof, that the upper and lower strata in which they were found, were formed in succession. The rapid progress of the science of chemistry, will, it is to be hoped, ere long, dispel the darkness, and furnish a solution to this hitherto unexplained phenomenon.

The great trap mass of Teesdale shews itself on the south bank of that river, just opposite to Middleton, in Teesdale, and extends to a great breadth to the Chain-bridge, where it forms the bed of the river, which has worn a deep chasm through it. At the Highforce (a waterfall of 70 feet perpendicular) the river has worn its bed completely through it, and shews it resting on the encrinite limestone, and dipping regularly to the NE. at an angle of not more than 12° with the horizon. Here may be distinctly seen, on the right side of the waterfall, the great Marbeck vein, intersecting both the trap and the limestone. This fact is interesting, as to the relative age of this trap, shewing it must have been in existence previous to the formation of the veins which pass uninterruptedly from the other strata through it. I am informed by miners this is always the case, and that they very frequently bear ore. At Maisebeck, in Tyne Bottom, there is a rib of

solid ore of four inches, which intersects the trap. The specimens I have now the honour of laying before the Society, are from a vein which runs east and west in the basalt, which extends over this district immediately at the foot of Crossfell, and is at present working at the point where Troutbeck, coming from the south-west, joins the river Tees. The vein from which I obtained these specimens is supposed to be a prolongation of one at present working in Harwood. If this could be ascertained, I think it might lead to some very interesting speculations on the subject. My friend Mr Jobling of Newtonhall, to whose kindness I am indebted for much useful information, is not aware there are at present any veins raising ore in this district, but there are many old workings in the basalt.

The trap rises to a considerable elevation, and in prodigious masses, from the Highforce to the south of Croakley and Croakley Fell, and at Cauldron Snout, about six miles NW. from the Highforce, where it again interrupts the progress of the Tees, and gives rise to a succession of beautiful cascades, to the height of 200 feet. Here it rests on the same limestone, and is covered to the NE. by a white and highly crystalline quartz-rock, which is intersected in every direction by bearing lead-veins, which the miners say penetrate the trap, but, owing to the hardness of the substance, has not been profitable to work. The colour of the trap (of which you have here a specimen) is bluish-grey, a mixture of augite and white felspar in small crystals. It is extremely hard and tough, and the fracture inclined to conchoidal. It sometimes inclines to the columnar form, particularly at the Highforce, and other interesting sections in the neighbourhood. The dip of the trap corresponds with that of the other strata NE. The most intelligent miners are of opinion that this rock may be traced for above thirty miles to

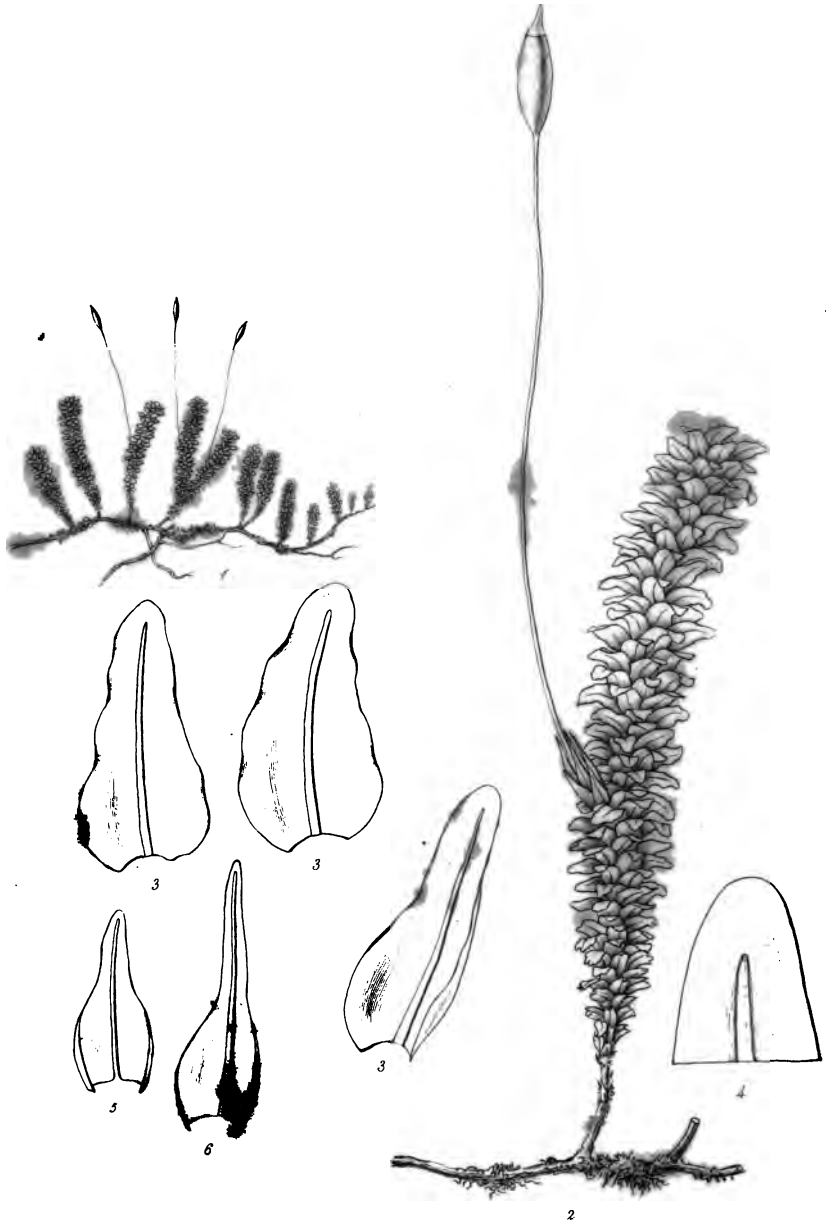
the south of the above described boundaries. They consider it as perfectly stratified, and estimate its depth from 12 to 18 fathoms. The extent of this field of trap is of prodigious magnitude. Its length from N. to S. must exceed 70 miles, and in many situations its breadth is from 12 to 15 miles.

From what source this great trap-range is to be traced, is a subject upon which the most highly enlightened geologists, mineralogists, and chemists, are as yet at variance. By some it is believed that this immense mass of greenstone has been poured out from that singularly extensive and curious whin-dike (commonly called the Bolam, or Yorkshire Dike), which may be seen marked in all the geological maps. It may be distinctly traced from the German Ocean, near Whitby, a distance of above 70 miles, into the field under consideration. By others, it is contended, that it is the production of a vast volcanic eruption from the alpine chain at its head. To others, again, there appear strong reasons to suspect either of these possibilities: 1*st*, The source from which it is supposed to flow, is not known to contain any metallic ores; 2*dly*, The substance in this great extent appears to have no tendency to vesicular concretions, or any vitreous appearance; and, 3*dly*, Its regular stratification for so great a distance, induces belief, that its formation has been in contemporaneous succession with the various strata forming the successive and curious alternations in this interesting district of the lead-measures.

The vast extent of this mass of trap or greenstone, its *stratification*, its veins of galena, its relations with the neighbouring strata, render it highly deserving of the attention of the geologist and the miner.

The present notice, although very imperfect, will, I trust, lead to a farther examination of the trap-rocks of

the north of England, and also to a comparison of the phenomena of their various junctions, alternations, and intermixtures with those exhibited in other parts of England and particularly in Scotland, a country eminently distinguished for the varied and highly interesting displays of the formations of the trap-rocks.



Nodaria Americana

K. Greville del.

R. Miller scul.

XXVIII.—*Descriptions of Two New Species of* Musci, *belonging to the Genera* Neckera *and* Hypnum.

By Robert Kaye Greville, LL.D. F.R.S.E. &c.

(*Read 30th April* 1825.)

Neckera Americana, *Grev.*

N. Americana; caulibus repentibus, ramis erectis; foliis patentibus, integris, ovato-oblongis, apicibus rotundatis, nervo apicem versus evanescenti; theca oblonga, erecta, seta elongata. Tab. XIV.

Hab. Trunks of trees (and on rocks?) in the United States. D. B. Greene, Esq.

Stems creeping, much entangled, throwing up numerous, erect, nearly simple branches about an inch or more in height. *Leaves* very numerous and closely set, spreading horizontally, ovate-oblong, or, sometimes, almost cordate-ovate, somewhat undulate, entire at the margin, much rounded at the extremity, the nerve strong, and disappearing at some distance from the summit. *Substance* very soft, thick, dense, and injured by the slightest touch in dissecting. *Colour* rather pale, of an opake and pleasant green, brownish on the lower part of the branches. *Perichætial leaves*—outer ones short, broadly ovate at the base, concave, contracted above into a short lingulate obtuse apex; innermost ones with their upper portion longer, and nearly linear, the nerve disappearing beneath the point. *Fruit-stalk* lateral, about three-fourths of an inch in length, pale yellow, slender. *Capsule* oblong; *lid* conical and rostrate. *Peristome* I have not seen.

TAB. XIV. Fig. 1. Plant natural size. 2. Part of a pl
3. Cauline leaves. 4. Summit of a cauline leaf.
chætial leaf. 6. Inner do.—All magnified, except

This interesting Moss unquestionably belon
nus *Anomodon* of Drs HOOKER and TAYLOR.
however, perfectly convinced of the expedienc
nus, I have preferred, for the present, pla
species in the genus *Neckera*, at the expe
Anomodon itself was constituted. *Neckera*
very nearly related to *N. viticulosa* (*Anomodo*
Musc. Brit.), and has the same peculiar habit
growth, leaves of the same dense and fragil
a fruitstalk and capsule nearly similar. In
it is much smaller, the leaves are little more
length, rounded at the extremity, and the ne
at a considerable distance from the summit.
is also shorter.

The great resemblance between these two
escape the most careless muscological obser
suggest to many the existence, though in an in
of the same relation between some of the C
plants of Europe and North America that has
between numerous Phænogamous plants. I
hazardous, in the present state of muscology,
this subject, any more than on the general geo
lations of mosses; especially as from what we
find the observation to be correct, that the l
scend in the scale of vegetation, the less the dis
plants over the surface of the globe seems to
by the laws that influence the more perfect vege
Nevertheless, we do not find in the mosses a di
a marked geographical distribution altogether
The curious genera *Phascum Voitia* and *Tetra*
to be confined to temperate and cold region

mostly limited to Northern Europe. On the other hand, *Calymperes* requires a considerable temperature; and the genus *Hookeria* containing, according to Dr HOOKER and myself, thirty species, besides doubtful ones, is, with the exception of two species, wholly extra-european. It is also worthy of notice, that, in the extensive genus *Orthotrichum*, of which we have published fifty-nine species, all those not found in Europe and North America, possess a peculiarity of habit at once recognisable, and for the most part also a difference in structure. That singular group, too, of mosses, denominated *Leptostomum* by Mr BROWN, has hitherto been only found in New Holland, Van Dieman's Land, New Zealand, and at Cape Horn. From these few facts alone, selected from various others that might have been brought forward, we have some reason for concluding that, at a future period, the distribution of the mosses will be found to be a more interesting subject than we at present anticipate; and that, even in those large genera, which now appear to scatter species indiscriminately over every country of the globe, sectional groups will be found, affecting perhaps different temperatures and latitudes from the rest.

HYPNUM REMOTIFOLIUM, *Grev.*

H. remotifolium; caule vage ramoso decumbenti, ramis elongatis, laxis; foliis subpatentibus, remotis, late-ovatis, acuminulatis, subconcavis, per totam longitudinem serratis nervo infra apicem evanescenti; theca cernua, operculo, conico, oblique rostrato.

HAB. South America, on the ground; communicated by Professor JAMESON.

Plant of a yellow or pale green colour, reddish-brown towards the base. *Stems* 2—4 inches in length, decumbent, variously divided,

the branches elongated, lax, attenuated towards their extremities, and irregularly set with lax spreading ramuli. *Leaves* shining, remotely and loosely set on the stem, spreading almost horizontally, broadly ovate, with a small acumination, somewhat concave, sharply serrate from the very base to the apex; nerve disappearing below the summit. *Perichætial leaves* erect, broadly ovate below, suddenly contracting, and terminating in a lanceolate apex, entire and nerveless, and very pellucid. *Fruit-stalk* nearly an inch in length, smooth, red. *Capsule* short, cernuous, deep red. *Lid* shortly conical, with an acute suboblique rostrum.

This species is at first sight so remarkable for the remote and lax manner in which its leaves are set on the stem, that I have given it a name expressive of this character. It is also well marked, by the cauline leaves being serrated from the point of insertion to the apex; those of the perichætium being quite entire and destitute of a nerve.

Hypnum remotifolium was sent with some other mosses as packing in a chest of geological specimens, which the President of this Society received from South America. It is a proof how easy a thing it is, under some circumstances, to assist scientific investigation, by communicating what appears to be the commonest objects from a distant country. I can assure those gentlemen who have occasion to send packages of minerals and other things from different parts of the world, that, by using mosses, lichens, &c. as materials for packing, they may greatly enrich the collection of the muscologist, and forward the progress of this department of natural history.

EDINBURGH,
May 5. 1825.

Engd for the Wern Memoirs Vol. V. p. 497.

Fig. 5

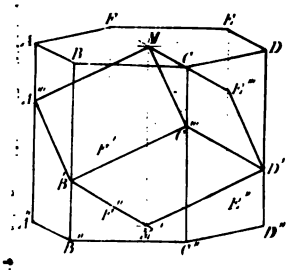


Fig. 6.

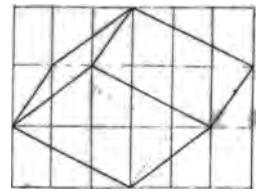


Fig. 11.

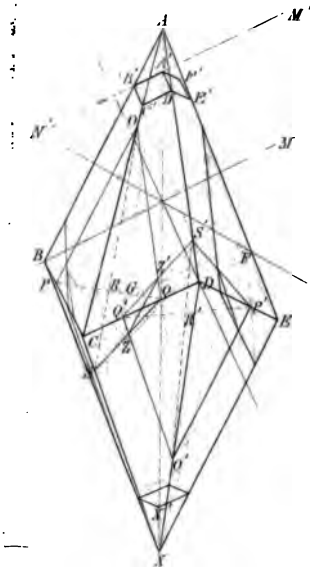


Fig. 12.

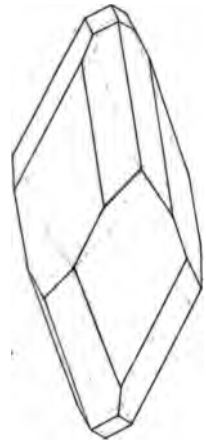


Fig. 17.

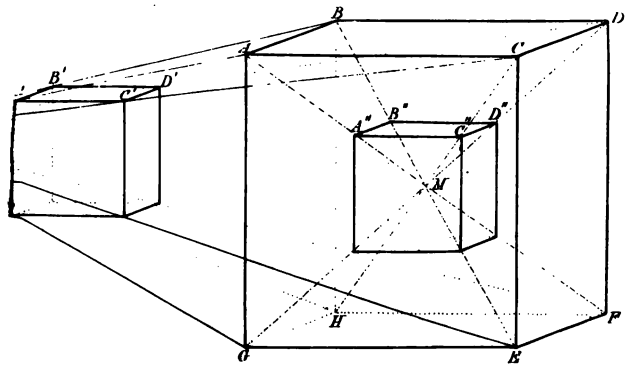


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Fig. 5.

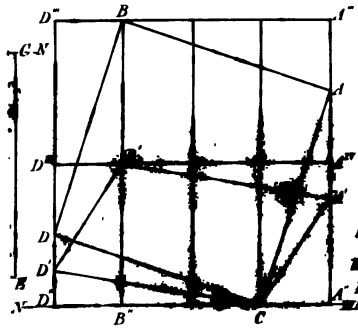


Fig. 6.

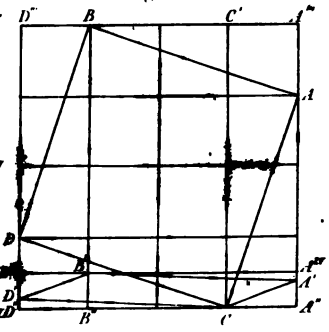


Fig. 11.

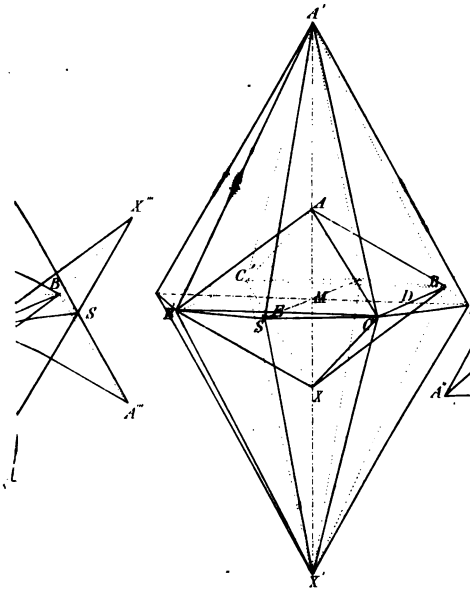


Fig. 12.

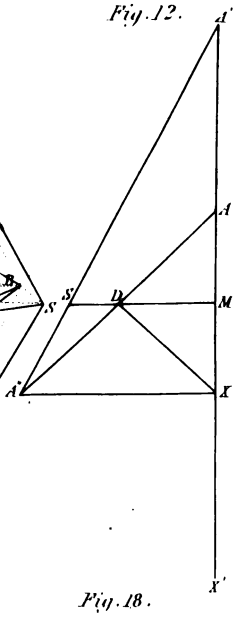


Fig. 16.

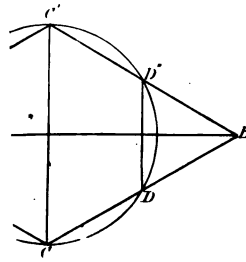


Fig. 17.

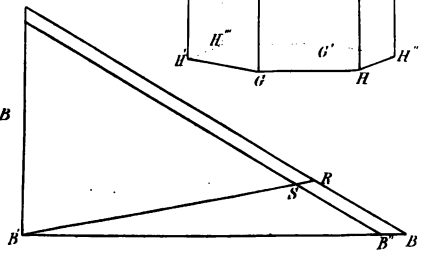
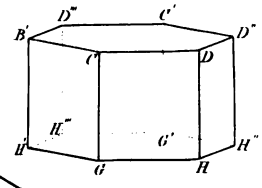


Fig. 18.



W. H. Linars sc.

XXIX.—*Account of the Method of Drawing Crystals in True Perspective, followed in the Treatise on Mineralogy of* Professor MOHS.

By W. HAIDINGER, Esq. of Vienna, F.R.S.E. Member of the Wernerian Society, &c.

(*Read* 14*th May* 1825.)

ALL those who have devoted their attention to the study of Crystallography, must have experienced many difficulties arising from the want of a proper method of drawing the projections of crystals, an object which, at the same time, should be effected with perfect ease, and with sufficient accuracy. Those who already possess the required crystallographic knowledge, will, indeed, very soon be capable to draw up rules for themselves; but this knowledge is not yet so generally diffused as it deserves, both for the influence it is likely to take in the progress of the science, and for the wonderful regularity of nature which it displays. The very attempt of drawing crystalline forms is inseparable from a close examination of these, and therefore a step forwards in studying crystallography; we may acquiesce in giving a vague verbal description of a crystal, but a vague representation of its figure seems to imply some im-

possibility for any person who is accustomed to accurate investigations. It is to a great extent the use of correct figures which has given Haüy's crystallographic method that great superiority which it has always enjoyed over the Wernerian method, both in accuracy and elegance; and to the study of Haüy's plates, far more than to the study of his writings, we must look as the point from which the subsequent labours of crystallographers started.

By far the greater number of the figures in the first edition of Haüy's *Traité* are executed with care, and according to the best method which could possibly have been adopted. Since the appearance of that work, most of the authors of crystallographic publications have followed the same plan, while others have more or less deviated from it. Many of the figures contained in the works of the present day, it must be owned, are much inferior to Haüy's, in point of correctness. It is, however, but very lately, that an introduction to a method of projections has been thought worthy to receive a place in systematic works on crystallography, and of these I shall only mention here the *Traité de Crystallographie* by Abbé Haüy, and the *Introduction to Crystallography* by Mr Brooke. The graphic method, which it is the object of this paper to develop, is that followed by Professor Mohs; it is equally distinguished by the easiness in its application, and the accuracy of which it is susceptible.

A useful representation of a crystal must contain every thing remarkable and requisite, for identifying it with the original in nature. Its chief object is, therefore, to express the relative position of the faces, and consequently the parallelism of those edges, which are parallel in the crystals themselves. This object can only be attained, if we suppose the eye of the observer to be at an infinite distance from the solid which is to be represented, in order to have

all those lines parallel which may be drawn from the eye to any of its points whatever. Suppose, now, a plane to cut all these lines, or the visual ray, at right angles; draw perpendicular lines from every solid angle of the solid upon that plane, the intersections with it will be the projections of the solid angles; join these points by straight lines with each other, the result will be a figure representing the crystal itself.

In the art of drawing in perspective, this method is called the Orthographic Projection, on account of the right angle, which the visual ray includes with the plane upon which the solid is represented. Herein it differs from the method followed by several modern authors, in which it is supposed that the eye of the observer is at once in two different places; but it agrees with the method employed in the works of Haüy. If the relations of the simple forms among each other be known, according to the crystallographic methods of Haüy, of Weiss, and others, but, particularly, if attention be given to the derivation of the simple forms from one another, and the laws of their combination, as proposed in the method of Professor Mohs, it will not be attended with the slightest difficulty to draw the figures of the most complicated crystals which may occur, if only the projection of one of the simple forms contained in them, have been previously completed; because the situation of the edges in the compound forms depends solely upon the intersection of the faces of the simple ones, and upon the ratios of certain lines similarly disposed in the single forms, which enter into the combination.

The first object to be attained, will therefore consist in projecting the figure of a form that may answer this purpose; and as the most appropriate, we may select the hexahedron, or, in the purely geometrical mode of considering it, the right rectangular four-sided prism, whose sides are

squares. (Plate XV. Fig. 1.*) It will form the first member of a series of problems, to be considered in two sections, referring to the method of projecting the simple forms, and the combinations, in which they are found in nature.

Section I.

Of the Projections of Simple Forms.

Problem I. *To draw a Hexahedron.*

Suppose one of the faces of the hexahedron (Fig. 1.) to be perpendicular to the visual ray. Its projection upon another plane perpendicular to the same line will also be a square, equal to the above mentioned face of the hexahedron. Suppose this square (Fig. 2.) to revolve round a line M N, parallel to C D; the points A and B will appear depressed in the lines A C and B D, while the length of C D remains unaltered; the projection of the square, therefore, assumes the appearance of a rectangular parallelogram. But in the hexahedron (Fig. 1.) at the same time, the face C D E F is turned round C D, and the projection of the two faces assumes the figure of two parallelograms (Fig. 3.) If we still continue to revolve the solid in the same way, the projection of A C and B D will diminish in length, while that of C E and D F increases till it becomes equal to C D, when the face C D E F (Fig. 4.) is brought into a plane perpendicular to the visual ray.

If the horizontal line M N is not parallel to C D, Fig. 5., the revolution round it cannot give rise to any rectangular

* For the figures which accompany this paper I have been indebted to Robert Allan, Esq. younger of Laurieston. They have been carefully executed in conformity to the rules which they serve to illustrate.

figures; for while B moves downwards in the direction of $B B^{II}$, A is depressed in that of $A A^{II}$, and D in that of $D D^{II}$. The limits of this change are, the coincidence of B with B^{II}, of A with A^{II}, and of D with D^{II}, which makes the projection of the angle $B A C = B D C = 0$, that of the angle $A C D = A B D = 180°$. It is evident that the ratio of $A A^{II}$ to $A^{I} A^{II}$ must be equal to that of $B B^{II}$ to $B^{I} B^{II}$, and of $D D^{II}$ to $D^{I} D^{II}$, because we may imagine the square A B C D to be part of a rectangular triangle revolving round one of its sides; a triangle produced in the above figure by lengthening M N till it is intersected by B A and B D. But the ratio of $A^{IV} A^{I} : A^{IV} A^{II}$ being equal to that of $A^{III} A : A^{III} A^{II}$, it will also be equivalent to that of $A^{II} C : A^{II} D^{II}$, for the equality and similarity of the triangles $B A^{III} A$, $A A^{II} C$, $C D^{II} D$, and $D D^{III} B$.

The ratio of $A^{II} C$ to $A^{II} D^{II}$, and that of $B^{I} B^{II}$ to $A^{II} D^{II}$, depend therefore entirely upon the choice of the position in which the hexahedron is to be represented; but the ratio of $A^{IV} A^{I}$ to $A^{I} A^{II}$ is a consequence of the two suppositions. If, for instance, we suppose $A^{II} C = \frac{1}{4} A^{II} D^{II}$, and $A^{IV} A^{II} = \frac{1}{8} A^{II} D^{II}$, the projection of the square upon a plane perpendicular to the visual ray will be that represented Fig. 6., denoted $A^{I} B^{I} D^{I} C$. This is the position adopted in M. Mohs' Works, for the figures of crystals belonging to the pyramidal and tessular systems.

The projection of the square A B C D having thus been obtained, upon a plane perpendicular to the visual ray, it is required to find the length of those lines which in the projection appear vertical, and represent the lateral edges of the hexahedron.

Suppose Fig. 7. to be a vertical section, in the plane of the visual ray. The line $B B^{II}$ in this figure will be the projection of the face B A C D in Fig. 6. If this line be turned round the point B^{II} (which is the projection of the

line $A^{II} D^{II}$) till $B^{II} L$ (Fig. 7.) becomes equal to $A^{II} A^{IV}$ (Fig. 6.), the edges of the hexahedron $B K^{I}$, $B^{II} G^{I}$ will assume the situation of $B^{I} K$, $B^{II} G$, and the line $B^{II} H$, which is determined by drawing G H at right angles upon the continuation of $B B^{II}$, will be the required length of the perpendicular lines in the projection.

By the length $B^{II} H$, taken upon $A^{III} A^{II}$, $C^{I} C$, $B B^{II}$, $D^{III} D^{II}$, from the angles A^{I}, C, B^{I}, D^{I} of the projection of the square, is determined the place of the four other solid angles of the hexahedron, which is thus completed, similar to Fig. 1.

In order to express these processes analytically, let $A^{II} D^{II}$, the distance of the two extreme edges, be $= a$; $A^{II} C$, the distance of one of these from the adjacent interior one, $= \frac{a}{n}$; $A^{IV} A^{II}$, the height of the projection of the terminal square, $= \frac{a}{m}$; and, moreover, the length of an edge of the hexahedron $= b$.

From the rectangular triangle D C D^{II} follows,

$$b = \frac{a}{m\,n} \sqrt{(m^2 (n-1)^2 + n^2)};$$

And from the similarity of the triangles $B^{I} L B^{II}$ and $B^{II} H G$, Fig. 7.,

$$B^{II} H = b \sqrt{\frac{m^2 - 1}{m^2}}.$$

If, as in M. Mohs' Works, $A^{II} C$ is $= \frac{a}{4}$, $A^{IV} A^{II} = \frac{a}{8}$, or $m = 8$, and $n = 4$, we have

$$b = a \sqrt{\frac{37}{64}}, \text{ and}$$

$$B^{II} H = b \sqrt{\frac{63}{64}} = a \frac{\sqrt{63 \times 37}}{64}.$$

Thus it appears that this method of projection may, with

the greatest facility, be subjected to such calculations as should be rendered necessary by some particular question; but it will be always found more convenient to follow the graphic process developed above, in which the only thing required for attaining the greatest precision, is some accuracy in employing rulers and compasses.

Having succeeded in projecting the hexahedron, we find ourselves enabled to resolve a great many problems respecting crystallographic drawings, some of which may here be considered, in order to attach to them a few observations relative to certain advantages in executing the projection.

Problem II. *To draw a regular Octahedron.*

If the octahedron and the hexahedron are brought into a parallel position, the only one in which they are produced by nature in one and the same crystal, the pyramidal axes of one of these forms coincide with the pyramidal axes of the other, and consequently there will exist an octahedron, whose size is exactly such, that its solid angles touch the faces of the hexahedron in their centres. Hence, determine the centres of these faces C, C^{I}, C^{II}, C^{III}, C^{IV}, and C^{V}, Fig. 8., and join them by straight lines, the result will be the octahedron.

Problem III. *To draw a given Isosceles Four-sided Pyramid, for instance,* P *of Pyramidal Zircon.*

According to Mohs, a in this species is $= \sqrt{0.8204}$,* that is to say, the axis of the pyramid P is $= \sqrt{0.8204}$, the side

* '*Treatise on Mineralogy*,' vol. ii. p. 368. The measurements upon which this quantity depends, were taken upon the small, but beautifully formed, crystals which accompany the native platina, and agree exactly with the results obtained by Dr Wollaston, and Messrs Brooke and Phillips.

of its horizontal projection being = 1. Draw A B the vertical pyramidal axis of the hexahedron, Fig. 9. Take $A B^{I} = A B\sqrt{0.8204}$, $C D = C^{I} D^{I} = C^{II} D^{II} = C^{III} D^{III} = \frac{1}{2} A B \sqrt{0.8204}$, and join the lateral angles D, D^{I}, D^{II}, D^{III} by straight lines with the apices A and B^{I} of the pyramid; the result is the required pyramid P of pyramidal Zircon.

Problem IV. *To draw the Pyramid* $(P)^{5}$ *of Pyramidal Zircon.*

We obtain an eight-sided pyramid by the following process. 1. Produce the axis of the four-sided pyramid on both sides to an indefinite, but equal length; 2. Enlarge the faces of that four-sided pyramid from which the eight-sided one is to be derived; 3. Draw triangles upon them, equal and similar to those of the pyramid, the bases of the triangles coinciding with the base of the pyramid; 4. Join the lower points thus determined with the upper apex, the upper points with the lower apex of the lengthened axis; and, 5. Pass planes through every one of these lines and the adjacent lateral solid angles of the original pyramid.

The rule for drawing the figure of an eight-sided pyramid will therefore be thus. Project the four-sided pyramid as above. Lengthen the axis A X (Fig. 10) till $A^{I} X^{I}$ is $= 3 A X$, the pyramid required being $(P)^{5}$. Draw $C A^{II} B^{I}$ equal, similar, and opposite to $C A B^{I}$ in the prolongation of its plane; in like manner $C X^{II} B^{I}$, $C X^{III} B$, $C A^{III} B$, &c. Join A^{II}, A^{III}, &c. with A^{I}; X^{II}, X^{III}, &c. with X^{I}; B, C, B, X^{I} with both A^{I} and X^{I}, and also with the intersections S, S^{I}, &c. produced by the lines $A^{I} A^{III}$ with $X^{I} X^{III}$, $A^{I} A^{II}$ with $X^{I} X^{II}$, &c. The result will be the projection of the pyramid $(P)^{5}$.

The same pyramid will also be obtained by proceeding

upon the following rule. Project the isosceles four-sided pyramid A B C B^I C^I X (Fig. 11.) as above. Bisect its lateral edges, B C in D, C B^I in E, &c. In the continuation of M D, M E, &c. take S D = ½ M D, S^I E = ½ ME, &c. and join all the points S, C, S^I, B^I, &c. by straight lines with the terminal points A^I and X^I of the lengthened axis, and the adjacent ones among themselves.

The latter process, being shorter, is preferable to the former one. It depends upon the property of the eight-sided pyramids, that S D (Fig. 12.) is always equal to $\frac{m-1}{m+1}$. M D, m being the number of derivation of the pyramid. For, let A X be $= a$, $A^I X^I = m.a$, A^I M will be $= \frac{m}{2}.a$, and $A^I X = \frac{m+1}{2}.a$.

$$\text{Now, } A^I M : MS = A^I X : X A^{III},$$

$$\text{and } MS = \frac{A^I M \times X A^{III}}{A^I X}.$$

But $A^I M = \frac{m}{2}a$, $X A^{III} = 2$ M D, and $A^I X = \frac{m+1}{2}a$;

$$\text{therefore } MS = \frac{2m}{m+1}.MD,$$

$$\text{and } SD = SM - MD = \left(\frac{2m}{m+1} - 1\right) MD = \frac{m-1}{m+1}.MD.$$

In the present case, m being $= 3$, SD is $= \frac{3-1}{3+1}.MD$ $= \frac{1}{2}.MD$. The values of m most generally occurring in crystals, besides 3, are 4 and 5; these make S D $= \frac{3}{5}.MD$ for $(P)^4$, and $= \frac{2}{3}.MD$ for $(P)^5$.

Problem V. *To draw a Scalene Four-sided Pyramid, for instance, that of Prismatic Topaz.*

According to Mohs, the ratio of the axis, and the two diagonals of the base in this species, or $a : b : c$ is $= 1 : \sqrt{4.440} : \sqrt{1.238}$, or $= \sqrt{\frac{1}{4.440}} : 1 : \sqrt{\frac{1.238}{4.440}}$.

Draw the pyramidal axes A X, B B^{I} and C C^{I} of the hexahedron (Fig. 13.). Take $A^{I}M = X^{I}M = AM \cdot \sqrt{\frac{1}{4.440}}$, $C^{II}M = C^{III}M = CM \cdot \sqrt{\frac{1.238}{4.440}}$, and join the six points A^{I} B C^{II} B^{I} C^{III} X^{I} by straight lines, the result will be the projection of the required pyramid. The numerical values must be expressed in decimals, and taken from a scale.

Problem VI. *To draw a Right Rhombic Prism.*

It is evident, that the projection of any oblique-angular four-sided prism will be as easily obtained as the projection of a scalene four-sided pyramid, if we suppose it, in a similar manner, to be inscribed into the hexahedron. The prism being a pyramid, one of the axes of which only is infinite, the present case forms a corollary of the preceding one.

Let, for instance, the prism (Fig. 14.) which is to be represented, be that, whose transverse section is similar to the base of P in prismatic Topaz, or P+∞. The line $MC = MC^{I} = M^{I}C^{II} = M^{I}C^{III}$, will be equal to $MC^{IV} \sqrt{\frac{1.238}{4.440}}$.

Problem VII. *To draw a regular six-sided Prism.*

If M C be $= M C^{IV} \cdot \frac{1}{\sqrt{3}}$, the real transverse section of the prism will be a rhomb of 120° and 60°; and the prism itself may be transformed into a regular six-sided one, by truncating its more acute lateral edges $B^I B^{III}$, and $B B^{III}$ (Fig. 15.), and allowing the planes of truncation to pass through the centres D^I, D^{III}, E^{III}, E^I, &c. of the respective lines $C B^I$, $C^I B^I$, $C^{II} B^{III}$, $C^{III} B^{III}$, &c.

That this must give a correct result, appears, if we consider (Fig. 16.) the projection upon a plane parallel to the rhomb $B C^I B^I C$. The angle $D^{III} B^I D^I$ is $= 60°$, the triangle $D^{III} B^I D^I$ is therefore equilateral; now, in the regular hexagonal prism $C^I D^{III}$ must be $= D^{III} D^I$, and therefore likewise $= D^{III} B^I = \frac{1}{2} C^I B^I$.

Problem VIII. *To draw a regular six-sided Prism, whose lateral Planes are Squares.*

From the known equality of $B B^I$ and $B^I B^{III}$ in Fig. 14. inasmuch as these projections have been obtained from a hexahedron, it will not be difficult to find the length of $C C^I$ required for transforming $C C^{II} E^I D^I$, and consequently all the lateral faces of the six-sided prism into squares.

Suppose $B B^I$ to be $= 1$; B C, in the solid itself, will be $= \frac{1}{\sqrt{3}}$, and $C D^I$ therefore $\frac{1}{2\sqrt{3}}$. The portion $B^I B^{IV}$, that must be taken from that line $B^I B^{III}$, in order to transform $C D^I H G$ into a square, must be to that line in the ratio of $\frac{1}{2\sqrt{3}} : 1$, or $B^I B^{IV} = C G$ must be $= \frac{B^I B^{III}}{2\sqrt{3}}$,

which length is found by the following considerations. The equation $C G = B^{I} B^{III}$ is expressed in the proportion $C G : B^{I} B^{II} = 1 : 2\sqrt{3}$. It may be found, by means of the similar triangles $R B^{I} B$ and $S B^{I} B^{III}$ (Fig. 17.), if we take the lines $B^{I} B$ and $B^{I} B^{III}$ of the base equal to those of the intended figures, and R B equal to the projection of D C; the fourth proportional $S B^{II}$ being the line sought, equal to C G in Fig. 15.

Fig. 18. exhibits the projection of a regular six-sided prism, whose lateral faces are squares, as obtained from the projection of the hexahedron.

But there exists also a method of arriving immediately at the projection of this solid, by following a plan similar to that employed above in projecting the figure of the hexahedron.

Problem IX. *To draw a regular six-sided Prism, whose Sides are Squares, independently of the Projection of the Hexahedron.*

Draw the regular hexagon P Q R S I E (Plate XV. Fig. 1.) upon a plane perpendicular to the visual ray, in any position selected, in regard to a certain horizontal line U K, round which it is supposed to revolve. Whilst it is revolving, the apparent size of U K remains equal, but that of $T^{I} D^{I}$ (Fig. 2.) diminishes till it becomes = 0, when it is in the direction of the visual ray; for a certain relation between U K and $T^{I} D^{I}$, $= 1 : \frac{1}{3}$, which, in Professor Mohs' Works, is preserved in the projections of forms belonging to the rhombohedral system, the hexagon $P^{I} Q^{I} R^{I} S^{I} I^{I} E^{I}$, Fig. 2., will be the projection of the regular hexagon P Q R S I E of the preceding figure. The ratio between A B and A G is also in itself arbitrary, only

A B must always be = C D = D E = F G. In the figures of Professor Mohs' Treatise on Mineralogy it is = $\frac{1}{6}$ A G. It is evident, that if $R^1 W = \frac{1}{n} R W$, also $P^1 X$ must be $\frac{1}{n} P X$, and $Q^1 U = \frac{1}{n} Q U$. The ratio of O N : O G is dependent upon that of A B : A G, and is found by drawing perpendicular lines from all the angles of the hexagon upon the line O G, which is situated in a plane parallel to the visual ray. If A B : A D = 1 : 3, we obtain O N : O K = 1 : 5.

The apparent length of the lateral edges of the prism, the faces being squares, is found in the following way. Draw A B perpendicular to B D (Fig. 3.), B D being a vertical section of the plane upon which the figure is to be represented. Take B C = $O^1 G^1$ (Fig. 2.), and A C = T D, Fig. 1. Draw C E perpendicular to A C, and equal in length to P E (Fig. 1.); from the point E draw E D perpendicular to B D, the line C D will be the required length of the lateral edges of the hexagonal prism, which, applied to the projection of the terminal hexagon in Fig. 2., yields Fig. 4. the projection of the hexagonal prism itself.

This method of projecting a regular six-sided prism may likewise be conceived in analytical terms.

From the ratio of A B : A D (Fig. 1. Plate XVI.) being known, it will be possible to deduce that of O N : O K. Let A D be = a, O K = b, A B = $\frac{a}{n}$, O N = $\frac{b}{m}$; and P E = E I = I S = c. We derive the following equations:

$PE^2 = PB^2 + BE^2$; $EI^2 = EG^2 + GI^2$; $SI^2 = IN^2 + NS^2$, or

$$c^2 = \left(\frac{b}{m}\right)^2 + a^2; \quad c^2 = \left(a - \frac{a}{n}\right)^2 + \left(b - \frac{b}{m}\right)^2; \quad c^2 = b^2 + \left(\frac{a}{n}\right)^2$$

and consequently, by eliminating c from the two first we obtain

$$b^2 = \frac{(1-2n)\,m}{(2-m)\,n^2} \cdot a^2;$$

from the two last,

$$b^2 = \frac{(2-n)\,m^2}{(1-2m)\,n^2} \cdot a^2;$$

and therefore $\frac{(1-2n)\,m}{(2-m)\,n^2} = \frac{(2-n)\,m^2}{(1-2m)\,n}$;

which being resolved, gives

$$m^2 n^2 - 2m^2 n - 2mn^2 + 2m + 2n - 1 = 0,$$

$$m = \frac{n^2 - 1 \pm \sqrt{(1 - 2n + 3n^2 - 2n^3 + n^4)}}{n\,(n-2)}, \text{ and}$$

$$n = \frac{m^2 - 1 \pm \sqrt{(1 - 2m + 3m^2 - 2m^3 + m^4)}}{m\,(m-2)}.$$

For $n = 3$, m becomes $= \frac{8 \pm 7}{3} = \frac{1}{3}$ or 5, the former of which is excluded by comparing the result with the figure, and the only value left for m is $= 5$. The line O N, therefore, is $= \frac{1}{5}$ O K $= \frac{1}{5} b$. The ratio of the lines a and b themselves, being expressed by $\frac{b^2}{a^2} = \frac{(1-2n)\,m}{(2-m)\,n^2}$, is $= \sqrt{25} : \sqrt{27} = 5 : 3\sqrt{3}$.

The apparent length C D of the edge C E, parallel to the axis of the six-sided prism, is obtained from the similarity of the triangles C E D and A C B, and found to be $= c\sqrt{\left(\frac{p^2-1}{p^2}\right)}$, if we suppose B C $= \frac{b}{p}$, and c the real length of one of the sides of the regular hexagon. Since, by the preceding formulæ, c, as well as b, may be expressed by a and n, it will not be difficult also to express the length C D by means of the same quantities, although the expression thus obtained will not be so simple as that stated above.

The projection of a regular hexagonal prism, which is a member of the rhombohedral system, allows of a similar application in regard to forms of the same system, as the projection of the hexahedron in the forms of other systems.

Problem X. *To draw a Rhombohedron.*

Let, for instance, this rhombohedron be the one whose terminal edge is = 104° 28′ 40″, the same which Abbé Haüy considered as the primitive form of calcareous spar. Its axis is = 1.5 = 2.25.

Draw the regular hexagonal prism, whose sides are squares, in the position fixed upon, Fig. 5. Produce the lateral edges, till $A A^{II}$ is $= \frac{5}{2} A A^{I}$, equal to the given axis of the rhombohedron. Take one-third of the length of these lateral edges alternately from the upper and the lower hexagon, and join the points A^{III}, B^{I}, C^{III}, D^{I}, E^{III}, F^{I}, thus determined among each other and with the centres M, M^{I} of the adjacent terminal hexagons by straight lines The result will be the projection of the given rhombohedron. The projection of the actual fundamental rhombohedron of rhombohedral lime-haloide is obtained, if, instead of taking $A A^{II} = \frac{5}{2} A A^{I}$, we substitute the value $= \sqrt{2.1895}\, A A^{I}$.

If $M M^{I}$ or $A A^{II}$ is $= A A^{I} . \sqrt{4.5}$, the projected solid is the hexahedron.

If $O^{I} G^{I}$, in Fig. 2., is = 0, the method of drawing a rhombohedron becomes very simple, since it requires only to draw the vertical lines representing the projections of the lateral sides and the axis of the hexagonal prism at the regular distances (at equal distances, for $A^{I} P^{I} = \frac{1}{6} A^{I} G^{I}$, in Fig. 2.) from each other, and cross them at right angles by four equidistant horizontal lines, whose intersections

with the former determine the situation of the angles of the rhombohedron, as it appears from the inspection of the 6th figure.

Problem XI. *To draw a Scalene Six-sided Pyramid, for instance,* (P)^5 *of rhombohedral Lime-haloide, or the "variété métastatique" of Haüy.*

Having completed the projection M A B C D E F M^I (Fig. 7.) of the rhombohedron R, take N M = M M^I = M^I N^I, because here the number of derivation is = 3, which requires N N^I to be = 3 M M^I. Join the ends of the lengthened axis with the lateral angles of the rhombohedron by straight lines; the result will be the projection of the required scalene six-sided pyramid.

Problem XII. *To draw an Isosceles Six-sided Pyramid, for instance,* P, *or that which belongs to the Rhombohedron* R *of the same species.*

Project (Fig. 8.) the rhombohedron A B B^I B^{II} C C^I C^{II} X, and take A M = X^I X. Draw C C^{III}, C^I C^{IV}, C^{II} C^V parallel to the axis A X, and lengthen the lines B M, B^I M, B^{II} M, till they intersect the former in C^{IV}, C^V, C^{III}. Join the points B, C^{III}, B^I, C^{IV}, B^{II}, C^V, with each other, and with the points A and X^I, equidistant from M, the result will be the projection of the isosceles six-sided pyramid P, as it is represented in Fig. 9.

The preceding cases will suffice for obtaining the projection of any simple form we may desire, if the rules laid down in this respect be properly seconded by a knowledge

of the relations of the forms themselves, and of the relations they bear to each other. It will be useful, however, to illustrate, by a few examples, the method of drawing the figures of combinations.

Section II.

Of the Projections of Compound Forms.

Compound forms or combinations, in general, are those crystalline figures, which at the same time shew the faces of two or more simple forms. Every one of these may be obtained by sufficiently enlarging those faces which, in the compound form, are equal and similar to each other. The form of the combination may be defined to be the space included at the same time within all the forms entering into the combination. Hence the method of representing them in its greatest generality, will require to lay down, in the parallel position, the figures of all those simple forms which the combination contains, and to determine that part of them which, if they intersect each other, is not excluded by any one of these simple forms. In most cases we may dispense with proceeding upon this long and very often tedious way, but it will be necessary to shew it in an example.

Problem I. *To draw the Combination of the Hexahedron and the Octahedron.*

Project the two simple forms in parallel position, so that their centres may coincide in M, Fig. 10.

If we draw EF parallel to DB, and IK parallel to LP, through the centres of the respective edges of the hexahe-

dron, these lines will determine the situation of the points N, N^{II}, and N^{I}, N^{III}, in which the edges contiguous to one of the angles of the octahedron rise from the planes within which the hexahedron is contained. The part A N N^{I} N^{II} N^{III}, situated beyond the face T U V W of the hexahedron, will therefore be cut off by this face, and not appear in the combination at all. The same will be the case with all the other solid angles of the octahedron, and the combination itself will be contained under eight hexagons, the residue of the faces of the octahedron, and six squares, being the residue of the faces of the hexahedron.

The same result may be obtained by a shorter process, thus:

Project the figure of the octahedron, take $A N^{I} = R^{I} L = \frac{1}{n} A L$, $A N^{II} = S B = \frac{1}{n} A B$, $L R^{II} = S^{II} B = \frac{1}{n} L B$, and draw $N^{I} N^{II}$, $S S^{II}$, $R^{I} R^{II}$, which are the intersections of the face A B L of the octahedron with the three adjacent faces of the hexahedron. The same process applied to all the edges of the octahedron gives the intersections of all the faces of the two solids, which being expressed by straight lines, yield the projection of the combination wanted.

Having obtained the figure of a double combination, it will be easy to add the faces of a third, then of a fourth simple form, and so on; and here, as well as in the projection of the simple forms themselves, we may often take advantage of many circumstances, which will offer themselves to our attention in the practical attempt of laying down the representations of crystals, in the proportion of our actual information in regard to the various departments of crystallography.

Problem II. *To draw the Rhombohedral Combination* R. $(P)^5$. R+2, *of the Species of Rhombohedral Lime-haloide.*

Before all, it is necessary to fix the relative extent which the faces belonging to the different forms are meant to possess, in order to ascertain which of the simple forms is to be projected first, and the others applied to it, according to the rules of derivation and of combination. Nothing is more easy, if the combination contains only a few simple forms; but it requires some practice to find out the best order in which one of the simple forms is to be added after the other, if the combination contains a great number of them. A short time, however, devoted to the projections of the simple forms themselves, is the best assistance for those who intend to occupy themselves with representing combinations. In the present case, it will be most advisable to begin with the scalene six-sided pyramid $(P)^5$, and the process itself will therefore be as follows.

Project the pyramid $(P)^5$ or A B C D E F G X, Fig. 11, according to the rules given above (Sect. I. Probl. XI.) The edges of combination between R and $(P)^5$ are parallel to the opposite terminal edges of the rhombohedron, and to the lateral edges of the pyramid. The point C^1 in which one of the faces of R intersects the edge A C of the pyramid, and consequently the ratio of $A C^1$ to A C having been determined, it is required to draw the edge of combination $C^1 D^1$ parallel to the lateral edge C D of the pyramid, and likewise $C^1 B^1$ parallel to C B. By this process the ratio of $A B^1$: AB becomes equal to that of $A C^1$: AC, and so all round, till all the points $B^1 C^1 D^1 E^1 F^1 G^1$ have been determined, and those lines drawn which join these points with each other, and represent the edges of combi-

nation between R and $(P)^5$. A line $M^1 N^1$ parallel to $C^1 D^1$, or C D, or to M N, the edges of the rhombohedron R, and passing through the point B^1, denotes the direction of one of the terminal edges of R; its intersection with the axis A X, or A^1, is the apex of the rhombohedron itself, which enters into the combination. The lines $A^1 D^1$, $A^1 F^1$ joining this apex with the upper solid angles of the combination, complete the figure on this side of the centre; on the opposite side of which the same process must be gone through.

The third form to be combined with the combination of R and $(P)^5$ is R + 2, an acute rhombohedron, whose edges of combination with $(P)^5$ are parallel to the more acute terminal edges of the pyramid. A face of this rhombohedron, passing through an arbitrary point O of the obtuse terminal edge A C of the pyramid, will therefore produce the edges of combination O P and O Q, being the intersections of that plane with those of the pyramid A B C, and A C D. In order to find the point S, where the face of R + 2 intersects the lower opposite edge C X, take P R = R Q, and draw O R, which, duly lengthened, will intersect C X in S. The face O P S Q will represent one of the faces of R + 2, as it appears in the combination. There are six of these faces, three of them inclined to the upper apex, the three others inclined to the lower apex; one of the latter is $O^1 P^1 S^1 Q^1$ in the figure. But the faces O P S Q and $O^1 P^1 S^1 Q^1$ intersect each other in the line $Z Z^1$, which line is the lateral edge of R + 2, and, as such, parallel to O P and $O^1 P^1$, the edges of combination between this rhombohedron and the pyramid $(P)^5$, or A B and X E the terminal edges of the latter form itself. The result, in completing the combination, by drawing the four remaining faces of R + 2, is the form represented in Fig. 12.

Problem III. *To draw the Pyramidal Combination* P. $(P)^5 \cdot \frac{3}{2\sqrt{2}} P + 3 \cdot P + \infty$, *of the Species of Pyramidal Zircon.*

Project the hexahedron $ABCDA^{II}B^{II}C^{II}D^{II}$ (Fig. 13.) according to the rules given above (Sect. I. Probl. I.). Take $AA^{I} = \frac{1}{2} AA^{II} \cdot \sqrt{0.8204} = CC^{I} = DD^{I} = BB^{I}$. By joining the points A with D, and B with C, determine the situation of M, the centre of the square ACDB; and, finally, draw the lines MB^{I}, MA^{I}, &c. and $B^{I}A^{I}$, $A^{I}C^{I}$, &c. The result $MB^{I}A^{I}C^{I}D^{I}$ is one part of the isosceles four-sided pyramid required, which, if likewise applied on the opposite side of the axis MM^{I}, will complete the combination of P with $P+\infty$. The length $A^{I}A^{III}$, &c. is quite indifferent, and depends upon the relative size of the same lines in those natural combinations which are to be represented.

The next form to be added is $(P)^5$.

Take $C^{I}O = \frac{1}{5} CM$, $C^{I}P = \frac{1}{5} C^{I}A^{I}$, $C^{I}P^{I} = \frac{1}{5} C^{I}D^{I}$, and $C^{I}Q = \frac{2}{5} CC^{I}$, or in general $C^{I}O = \frac{1}{n} CM$, $C^{I}P = \frac{1}{n} C^{I}A^{I}$, $C^{I}P^{I} = \frac{1}{n} C^{I}D^{I}$, and $C^{I}Q = \frac{2}{n} \cdot CC^{I}$, and draw the lines OP, OQ, OP, and PQ, $P^{I}Q$; the faces OPQ, $OP^{I}Q$ will be those parts of the faces of $(P)^5$, which appear in the combination. This becomes quite evident, if we consider the dimensions of that eight-sided pyramid, and its relations to P. Since $(P)^5$ belongs immediately to this four-sided pyramid P, the edges of combination between the two forms must be parallel to the opposite terminal edges of the latter, OP therefore parallel to MA^{I}; and if this edge of combination be supposed to coincide

with the terminal edge M A^{I}, that part M M^{III} of the axis, which corresponds to its terminal edge M C^{III}, must be equal to three times the part M M^{I}, which corresponds to the terminal edge M C^{I} of the four-sided pyramid. The last is indicated by the exponent 3 in the sign of the eight-sided pyramid. If the same process, by which the faces O P Q and O P^{I} Q have been obtained contiguous to the angle C^{I}, be applied to every one of the other solid angles similarly situated, all the faces of $(P)^{3}$, sixteen in number, will be produced, and thus the triple combination P. $(P)^{3}$. P+ ∞ completed, as it is represented in Fig. 14.

The fourth and last of the simple forms to be added to the preceding combination is $\frac{3}{2\sqrt{2}}$ P+3. The axis of P+3 is $= 2\sqrt{2} \,.\, a$, a being the axis of P; that of $\frac{3}{2\sqrt{2}}$ P+3 therefore $= 3 \,.\, a$. A face of this form, passing through the point C^{III}, or through the horizontal line A^{III} C^{III}, will at the same time pass through the line M C^{III}, which is one of the terminal edges of $(P)^{3}$. The edges of combination between these two forms are therefore parallel to the alternating terminal edges of the eight-sided pyramid, and also to the terminal edges of the four-sided pyramid. Hence the quadrangle R S U T in Fig. 14. will be one of its faces, the angles of which are determined by taking W S $= \frac{1}{n}$WY, V R $= \frac{1}{n}$VX, V T $= \frac{1}{n}$VZ, and W U $= \frac{1}{n}$WK. The junction of these points by straight lines gives the outline of the face. If repeated on all the homologous edges, this process finally yields the 15th figure for the pyramidal combination of P. $(P)^{3}$. $\frac{3}{2\sqrt{2}}$ P+3. P+ ∞, in the species of pyramidal Zircon.

It would be superfluous to give here a greater number of examples for the process of representing complicated forms of crystals, as it is exactly similar, in every instance, also in the remaining systems of crystallisation. In many cases it may be useful, beside the actual representation of a crystal in perspective, according to the rules developed above, to sketch the horizontal projection, or the elevation of the crystal upon a certain plane, determined in respect to the axes of the combinations; it will be particularly important to make use of this method in hemi-prismatic and tetarto-prismatic forms, in which we are compelled to seek for symmetry, as referred to certain planes; while, in the other systems, it possesses an absolute and persistent character. In the latter, indeed, as Haüy observed, it would have the effect of monotony; but it cannot be too much recommended to those, who already possess some knowledge of forms, for studying certain classes of the more difficult crystals in nature.

The result of applying the rules of projection to a particular case, is the representation of a variety given, or observed in nature upon a plane, without the auxiliary lines, which it was necessary to make use of for arriving at this result. To this end, we copy the points determined by the intersection of the lines, by means of the fine point of a needle, and join the points transferred in this way from one sheet of paper upon another, by means of straight lines, according to the indications of the original drawing. One original may thus serve for a great number of projections, since it may be copied whenever a new form is added; and the degree of attention bestowed upon the first outline is amply repaid by the exactness of the copies.

It has been the custom of Haüy and subsequent crystallographers, and it deserves to be retained, to draw the front edges in full lines, like A B, Fig. 16.; the back edges, like

C D, in dotted lines; to express lines drawn upon the surface of forms in interrupted lines E F; and lines in their interior by alternating dots and short lines, like G H.

Very often it occurs, particularly with beginners, who are not yet accustomed to judge rightly of the probable size of a form, to be obtained by several successive processes, that the result is either smaller or larger than is wished for, and a method is therefore desirable for enlarging or reducing it to a more convenient size. Draw to this end from any determined point, within or without the figure, towards every solid angle of the figure, a straight line, and take respectively equal parts of the whole upon these; the points determined will be the analogous points of the new figure. If, for instance, the hexahedron A F (Fig. 17.) is so much to be reduced, that the edge of the new figure becomes equal to two-fifths of the edge of the original, it will be necessary to draw N A, N B, N C, N D, &c. and to take upon these lines $N A^{I} = \frac{2}{5} N A$, $N B^{I} = \frac{2}{5} N B$, $N C^{I} = \frac{2}{5} N C$, $N D^{I} = \frac{2}{5} N D$, &c. The hexahedron is now completed by joining these points by the straight lines $A^{I} B^{I}$, $B^{I} D^{I}$, $D^{I} C^{I}$, $C A^{I}$, &c. In most cases, however, it will be more expeditious to draw the axes, like A F, B E, &c., or other lines, through the centre of the solid, and take upon these the same relative distances $A^{II} M = \frac{2}{5} A M$, &c., which will likewise yield a hexahedron, the side of which is equal to two-fifths of the side of the original form.

XXX. — *Account of some Fishes observed during* Capt. FRANKLIN *and* Dr RICHARDSON'S *Journey to the Polar Sea.*

(*Read 24th January* 1824.)

By Dr JOHN RICHARDSON, M. W. S. &c.

THE following zoological notices were originally drawn up, to be inserted in the Appendix to Captain Franklin's Narrative of a Journey to the Polar Sea; but to prevent that part of his work from swelling to an undue size, it was found advisable to exclude them, together with the detailed accounts of all the other species that were not deemed to have been previously undescribed. As the following descriptions, however, were taken from the examination of a great many recent specimens, and as they contain some details which have not hitherto been made public, and relate to species which may not soon come under the inspection of a naturalist, they are respectfully submitted to the Society.

* Coregonus albus. White Fish.

This fish has been long known to the fur-traders by the appellations of *Poisson blanc*, *White Fish*, or *Tittymeg*, the latter corrupted from the word *Attihhawmeg*, the name given to it by the Cree Indians. The Chepewyans and Copper Indians term it *Thlooæh*. It is noticed by Hearne under the name of *Tickomeg;* and Pennant, in Arctic Zoology, perhaps from the imperfection of his specimens, has confounded it with the *Salmo lavaretus* or *Guiniad* of British Zoology †. Very lately M. Le Sueur discovered it in the large lakes which bound the United States to the northward, and, adopting Artedi's genus of Coregonus, has described it correctly as a distinct species under the name of *Coregonus albus* ‡. This description, however, being merely intended for identification, is so brief, that I have been induced to record the following particulars, drawn up from the dissection and comparison of many individuals.

Shape.—The body is compressed, and, when viewed laterally, nearly ovate, tapering to form the tail. The back is arched, and in a fat individual very gibbous before the dorsal fin. The depth of a full-grown fish may be stated at one-third of its length; when fat it exceeds, and when lean falls short of, that proportion.

The *lateral line*, running nearly midway between the back and the belly, is arched under the first dorsal, from whence it runs perfectly straight to the caudal fin.

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* Genus *Salmo*, Linn.; *Coregonus*, Artedi.—Subgenus *Coregonus; Les Ombres*, Cuvier, 'Regne Animale,' vol. xi. p. 162.

† 'Arctic Zoology,' Introd. p. ccxviii. and vol. xi. p. 393.

‡ Le Sueur, 'Journal of the Academy of Sciences, Philadelphia,' vol. i. p. 232, with a figure.

The *colour* is bluish-grey on the back, lighter on the sides, and on the belly white. There are no spots on the body.

The *scales* are orbicular, with an even margin, and rather large, being half an inch in diameter. They are of equal size on the back and belly, and possess a bright pearly lustre. The opercula, cheeks, and irides, have the same lustre with the scales.

The *head* is small, compressed, and ends in an obtuse snout, which appears more pointed when viewed laterally. The infra-orbitar bones cover all the cheek. The vertex is clothed with a soft smooth skin.

The *eyes* are large, and the orbit is about one-third nearer to the extremity of the snout than to the posterior margin of the operculum.

The *nostrils* are double, and placed immediately before the anterior superior angle of the orbit. The membranous margin of the anterior opening answers as an operculum to the posterior one.

The *mouth* is small, and when shut its angles are depressed. It is somewhat four-sided when open. The superior and inferior maxillary bones form the principal part of its border; the intermaxillary bones are small, and very thin, and, through the medium of a cartilaginous articulation with the end of the snout, give an obscure motion to the upper lip, which descends obliquely. The maxillaries having a semi-elliptical figure, form the sides of the mouth with their curved edges. They are connected with the intermaxillaries through the medium of membrane, and are articulated with the snout by their rather pointed upper extremities: their lower extremities are rounded, and play upon the lower jaw, being aided in their motions by a small, loose, thin, ovate process. The jaws are of equal

length, and when the mouth is open project beyond the snout.

The *tongue* is cordiform, firm, and armed with extremely minute scattered teeth. There are also a few *teeth* on the jaws, but they are seen with difficulty, and are too slender to be felt. The palate is quite smooth.

The *branchiostegous membranes* are thick, from the quantity of muscle, and a shining membrane, which line their eight flat curved rays, and at their union with each other, on the throat, they form a few plicæ. The rays are narrower and smaller, the nearer they are to the mæsial ventral line. The innermost are very slender. The branchial arches almost encircle the œsophagus, their posterior ends being nearly in contact with each other, at their insertion into the basilary process. Each arch has a single row of erect subulate processes, about one-fourth of an inch long, which are rough on their inner surfaces. There are no pharyngeal bones.

On opening the abdomen, a multitude of cæca present themselves, involved in the folds of a membrane which is generally loaded with fat. This membrane is a production of the peritonæum, and bears a strong resemblance to an omentum. It descends about half-way down the abdomen, and conceals the stomach and liver, being closely attached to the former viscus by numerous vessels. A long spleen is attached to its right border.

The alimentary canal descends from the pharynx for about five inches, in form of a straight wide tube. The lining in this tube is disposed in six longitudinal rugæ, and is of a red colour, except an inch at its commencement, which is white, presents the appearance of a glandular structure, and may be considered as œsophagus. The red part of the tube, which may be named the upper part of the stomach, makes a sudden turn to cross the liver,

and, bending upwards, terminates in what may be denominated the proper stomach. The latter, an uniform sac, 2½ inches in diameter, bears, in its shape, and in the thickness of its coats, a strong resemblance to the gizzard of a fowl, but does not exhibit the same muscular structure. It consists, first, of a thin peritonæal coat,—then of a firm coat, of a clear gelatinous appearance, which forms the principal part of the thickness of its parietes, and when boiled separates into layers: next to this, there is a very firm, almost cartilaginous, layer; and the inner membrane of the whole is of a grey colour, and thick spongy substance, differing in appearance from the lining of the narrow part of the viscus. The rugæ of the œsophagus are continued into the dilated part of the stomach, but from their expansion they become nearly obsolete.

The pylorus is placed in the fundus of the oviform part, where it is nearly in contact with the thoracic septum or diaphragm.

The coats of the *first intestine* are thin, and the internal one exhibits a few longitudinal rugæ. A short way below the pylorus, it is encircled by the cæca, which continue to be inserted into it for about two-thirds of its length downwards. There are about 150 of them, an inch long, of a conical figure, and generally filled with a yellowish mucus. They are too slender to admit the grosser contents of the stomach.

The first intestine ends in a *rectum*. There is no valve at their junction, but the latter is easily distinguished by the well-marked folds of its internal membrane encircling the canal.

The first intestine is in proportion to the length of the body, as 9 to 16; the first and second together, as 13 to 16; and the whole alimentary canal as 19 to 16. These proportions, however, are only approximations, as the

length of the canal was found to vary considerably in different individuals.

The *liver* is small, obtusely triangular, without lobes, and lies over the œsophagus, and behind the cæca, and convolutions of the first intestine. The cystic duct has remarkably thick coats, and terminates in the first intestine, about half an inch below the stomach.

The *air-bladder* is large, extends the whole length of the abdomen, and sends a pretty wide tube into the upper part of the stomach.

The kidneys lie along the spine, the whole length of the air-bladder.

The dorsal fin, placed in the middle of the body, is subquadrangular, diminishing in height as it proceeds backwards. It contains twelve rays, the two first nearly simple, the posterior ones becoming gradually more forked; two small rays support the base of the first one. The adipose fin is acinaciform, or somewhat falcate in shape, with a broad attachment opposite the anal fin. The pectorals have sixteen rays, more or less forked, the interior ones becoming gradually shorter, which gives the fins a somewhat pointed acinaciform appearance. The ventrals, placed opposite the dorsal, are fan-shaped, and have eleven rays, all much forked. The outer ray is supported by a short one. The anal fin has twelve rays, is subquadrangular, higher anteriorly, and leaves a portion of naked tail behind it, equal to the length of its own insertion.

The caudal fin is crescentic: a quadrangular portion at its base is covered with scales. B. 8, P. 16, V. 11, A. 12, D. 12, C. 18 $\frac{6}{6}$ rays. This fish weighs in general about 3 lb., but those of 8 lb. are not uncommon, and they have been known to reach even 20 lb. When very fat, its shape is somewhat distorted, as it acquires a hump immediately behind the head. The very large fish increase

principally in circumference, their length suffering little augmentation. The ordinary length is about 16 or 18 inches.

The Attihhawmegh seems to prey on insects. Its stomach, however, is generally filled with earth, mixed with a few slender roots of vegetables, and some small white worms. It has been known, though rarely, to take a hook baited with a small piece of meat.

Some fine Attihhawmegh were caught at the mouth of the Copper-Mine River, and in Bathurst's Inlet, and they abound in every river and lake in the country. They form a most delicious food, and at many parts are used as the sole article of diet, for years together, without producing satiety. It spawns in the month of October.

We observed no difference in external appearance between the males and females.

* Coregonus Artedi.

Le Sueur, in the Journal of the Academy of Sciences, notices a fish under the name of *Coregonus Artedi*, or *Herring Salmon*, as occurring in the same lakes with *Coregonus albus*. The description there given is not sufficient to enable us absolutely to identify the one we are about to mention with his species, but, at the same time, the coincidences of character and habitat render it unadvisable for us to attempt to describe them as distinct.

Our fish is known to the fur-traders by the name of *Tullibee*, a corruption of its Cree appellation, *Ottonneebees*.

It bears a very strong resemblance to the *Coregonus*

* Genus *Salmo*, Linn.; *Coregonus*, Artedi.—Subgenus *Coregonus*; *Les Ombres*, Cuvier; *Coregonus* Artedi.—Le Sueur, 'Journal of the Academy of Sciences, Philadelphia,' vol. i. p. 231.

albus, or Attihhawmeg, their general figure, and the shape of their fins being nearly alike. It is, however, a more delicate-looking fish, from the comparative smallness of its organs.

Its body, viewed laterally, is broadly oblong, tapering rather suddenly to form the tail. Its back is straighter than that of the Attihhawmegh, and seldom gibbous. Its depth is one-third of its length. The body is compressed; the belly is obtuse; the back rather more acute; the greatest diameter near the lateral line. The *lateral line* is straight, until it nearly reaches the adipose fin, when it makes a very slight curvature upwards.

The colour of the whole body, when held opposite to the light, is silvery, with much lustre. In the shade, the back is greenish-grey, the belly white, and the sides of intermediate colours. The fins are bluish-grey; the opercula, cheeks, and irides, silvery. The scales are oblong, half an inch long, and of nearly uniform size over the whole body. The vertex is covered with a soft, smooth, bluish-grey skin.

The *head* is small, and, when viewed sideways, appears conical. The snout is short, and, when the jaws are open, appears truncated. In a dried specimen it looks rather pointed.

The *mouth* is smaller; and the lips, when open, project in a still less degree beyond the snout than those of the Attihhawmegh. Its orifice is transverse. The lower jaw is very slightly longer than the upper one, and has a small knob at its symphysis in the male, which is received into a depression, produced in the upper one by the smallness and recession of the intermaxillary bones.

The *teeth* on the jaws, if any, are too small to be felt. The tongue is heart-shaped, soft on the edges; but there is a small plate in its centre set with minute teeth.

The *bronchial arches* are set with solitary rows of long awl-shaped cartilaginous processes, serrated on their inner sides with two rows of minute teeth. The central processes of the upper arch are half an inch long, those on the other arches are smaller.

The œsophagus is short, and distinguished from the stomach by its white colour, and glandular appearance. Its internal membrane forms six large longitudinal rugæ. The stomach descends in a straight line from the œsophagus, for about an inch and a half; it is then bent upon itself, and runs upwards towards the septum, and terminates in the first intestine. The descending portion of the stomach is slender, the ascending part more dilated; both are lined by a continuation of the internal membrane of the œsophagus, and exhibit the same number of rugæ. This membrane is thick, and forms a projecting ring at the pylorus, where it evidently terminates. The ascending portion of the stomach differs remarkably from the same part in the Attihhawmegh, in the comparative thinness of its coats. Beyond the pylorus there is a sac of the same diameter with the fundus of the stomach, and like it directed upwards. It is lined by a firm, somewhat glandular membrane, perforated by the orifices of numerous cæca. At the bottom of this sac, the alimentary canal is again bent upon itself, and runs downwards in a straight line to the anus. In the upper part of this course the canal is slender, with delicate coats, and no rugæ: in the lower part, its diameter becomes greater, and its lining is disposed in circular plicæ, of a bright red colour, similar to the same part of the Attihhawmegh. About an inch of intestine next the anus is smooth, and somewhat dilated. There is no proper valve at the rectum.

There are about 120 cæca inserted into the sac above mentioned, and into the gut a short way below it. The

liver is triangular, with the apex directed downwards, and a small lobe at the upper end. The gall-bladder is large, being nearly half the size of the liver. The gall-bladder is a little dilated at its termination, and terminates in the sac with the cæca. The spleen is long and large. The milt is of a wood-brown colour.

B. 8, P. 16, V. 12$\frac{2}{2}$, A. 12, D. 12$\frac{1}{2}$, C.

Dimensions of an individual of the ordinary size.

Length, exclusive of caudal fin, - -	14 inches.
——— from snout to anus, - - -	11$\frac{1}{2}$
Depth where greatest, - - - - -	4$\frac{1}{2}$
Length of gut from pylorus to anus, -	9
——— of stomach and œsophagus, -	2$\frac{1}{2}$
Whole length of intestinal canal, - -	11$\frac{1}{2}$

The habits and food of this fish appear to differ but little from those of the Attihhawmegh, notwithstanding the great difference in the structure of their stomachs. It is inferior to that fish as an article of food, and is comparatively rare.

It is found in most of the lakes, and we caught some very fine ones in the sea at the mouth of the Copper-Mine River.

Hiodon Clodalis. Gold Eye.

The Canadian voyagers have long known this fish by the name of *Naccaysh*, the English fur-traders by that of *Gold Eye;* yet, from its being confined to the inland lakes, it does not appear to have been sent to Forster or Hearne, to whose investigations we owe all that is known respecting the Hudson's Bay fish. Its Cree name is *Oweepeetcheesees.* M. Le Sueur having met with it in the northern parts of the United States, constructed a new generic character *

for its reception,—a distinction which it well merits, as the want of an adipose fin, exclusive of differences in internal structure, keep it separate from the already heterogeneous Linnæan genus *Salmo;* and its organisation renders it equally unfit to unite with *Esox*, the only other genus with which it has any affinity.

Shape.—When viewed laterally, the outline of the fish, exclusive of the tail, is nearly oval, the curvature of the belly being a little greater than that of the back. The tail lies nearer the plane of the back than of the belly, and is much narrower than the body; hence it is connected at the anus with the curve of the belly by a sudden and very considerable slope, the whole of which is occupied by the anal fin. The body is greatly compressed. Its greatest thickness is just above the lateral line, or near the back. The belly has a very acute edge, free from serratures; the back is also acute, but in a less degree.

The *lateral line* lies nearer to the back than to the belly. It continues straight from the operculum till it passes the dorsal fin, when it is slightly deflected.

Colour.—The body has a silvery colour, with much lustre.

The *scales* are irregularly orbicular, and large, being about half an inch in diameter. The membrane that covers their bases has a bluish-grey colour.

The *head* is much compressed, and sideways appears conical, with an obtuse snout. There are no scales on the vertex, but the occiput is covered with a large scale on each side. The irides and sides of the head are tinged with honey-yellow, and have much nacry lustre. The infra-orbitar bones have in the aggregate a nearly circular out-

* *Hieden*, Le Sueur, 'Journal of Academy of Sciences, Philadelphia,' vol. i. p. 367. tab. 14.

line, and cover the whole cheek. The præ-operculum triangular, larger and stronger than the operculum, curves down upon the bronchiostegous membrane, and has a pearly lustre. A narrow, somewhat cartilaginous, border forms the posterior rounded margin of the operculum.

The *eye* is large, and its orbit approaches very near the margin of the mouth.

The *nostrils* are double, and placed above the angle of the eye, near the extremity of the snout. The valve of the posterior nostril is formed out of the membranous border of the anterior one.

The *mouth* is large for the size of the head, and its orifice descends obliquely downwards. When the jaws are extended, the upper one is nearly vertical, forming an angle of 70° with the lower one, which stands horizontally, and consequently appears the longer of the two. The maxillaries enter rather more largely into the composition of the margin of the mouth than the intermaxillaries. Both are narrow: the former linear, nearly immoveable, and articulated with the latter, whose somewhat dilated extremities project a little over the lower jaw, and move slightly forwards when the mouth opens.

Teeth.—The upper jaw is armed with a single row of conical teeth, the intermaxillary ones being considerably the largest. The lower jaw is strong, and armed with a double row of conical teeth, having their points directed backwards. Betwixt these two rows there is a narrow, bony surface, rough, with minute teeth. The vomer projects from the roof of the mouth, and is armed, like the lower jaw, with rows of strong conical teeth, and intermediate card-like plates. The palatine bones are rough, with minute teeth. The largest teeth of all are hook-shaped, and situate upon the margin of the tongue. The centre of the

tongue is covered with small hook-shaped teeth, densely crowded.

The *bronchiostegous membranes* are thick, and the left one overlaps the right at their insertion into the root of the tongue; they contain each nine small cylindrical rays. The gill-openings are large. The bronchial arches are furnished with double rows of club-shaped cartilaginous processes, rough with teeth. The posterior extremities of the arches are connected by soft membrane, the anterior ones by cartilages. At both extremities there are slight plates covered with small teeth.

Intestines.—The œsophagus, an inch long, is distinguished from the stomach by its more delicate and whiter rugæ. The stomach is a long sac, which makes a curve at its fundus. Its internal membrane forms nine or ten large longitudinal rugæ, of a reddish colour. The pylorus is very distinct, being much contracted. The gut is nearly of equal diameter throughout, except immediately below the pylorus, where it is dilated. Into this dilated part the gall-duct opens on the one side, and a short, wide, obtuse cæcum on the other. This solitary cæcum is three-fourths of an inch long. The internal membrane of the gut is soft and villous, without regular rugæ or plicæ. There is no distinct rectum. The intestines make one convolution. The fæces have a honey-yellow colour. The liver is linguæform, lies on the right side, with a small lobe on the left, and has a reddish-orange colour. There are two small spleens. The *air-bladder* is capacious, and communicates with the œsophagus. The kidneys are thickly spotted with dark-brown specks on a bluish-grey ground. The lining of the abdomen is of a pearly colour, the roe of a pure white.

Fins.—The *dorsal fin*, placed where the back slopes down to form the tail, and beginning opposite to the com-

mencement of the anal fin, is somewhat quadrangular, more elevated, however, anteriorly. It contains eleven rays, the first of which is short and simple; the second, which is the tallest in the fin, is also simple; the rest become gradually more forked and shorter as they recede backwards; the last is divided nearly to the base. The *pectorals* are somewhat pointed, and have twelve rays, of which the first is longer and stronger than the others, the posterior ones becoming gradually smaller. The *ventrals* somewhat fan-shaped, and of a moderate size, have seven forked rays. The *anal fin* is long, and occupies the long slope which the tail forms to unite with the belly at the anus. It becomes gradually narrower posteriorly, has a slightly waved margin, and contains thirty-four rays, of which the first is short, and covers the base of the second, which is the longest in the fin. They are all, except the first, more or less forked. The caudal fin is crescentic: the lower lobe rather larger than the upper one. It contains eighteen rays, the base of the outer ones supported on each side by six or seven smaller ones.

P. 12, D. 11, A. 34, V. 7, C. 187.

Dimensions of an individual.

Length, exclusive of the caudal fin, -	14 inches.
——— to anus, - - - - -	9
Depth, - - - - - - -	4⅝

This fish resembles the small trouts in its habits. It is caught at Cumberland House only in the spring. The specimens we saw there agree very well in general with the figure of Le Sueur above quoted, but the tail of his specimens appears to have been more forked, the mouth does not droop so much, and section, Fig. 2. is much more obtuse, both above and below, than in ours. In the Oweepeetcheesees the belly is much compressed, and very acute.

XXXI.—*Observations on the Habits, Appearance, and Anatomical Structure of the Bird named The Trumpeter,* Psophia crepitans *of* LINNÆUS, Agami *of* CUVIER.

By THOMAS STEWART TRAIL, M.D. F.R.S.E. M.W.S. &c.

(*Read 12th November* 1825.)

A LIVING specimen of this singular bird having been sent from Demerara by my friend Charles S. Parker *junior*, Esq., a zealous and accomplished naturalist, I had a favourable opportunity, in the summer of 1824, of noticing its habits. An accident which caused its death soon enabled me to examine its internal structure; and I detected so remarkable a peculiarity in the formation of its bronchial tubes, that I laid an account of it before the Literary and Philosophical Society of Liverpool, at the first meeting in October. Unwilling, however, to publish an account of this remarkable structure from a single dissection, I wrote to a young friend in Demerara to procure living specimens of the bird, and two were lately sent to me from that colony. Of these one died on the passage, and was immediately put into a small cask with rum; the other lived until the ship arrived, but died on that day, and was examined

a few hours after death. The most careful dissection of the organs of respiration in both birds, in which I was assisted by Dr Williams, completely confirmed the discovery which I had made, a year ago, of the *direct* communication between the trachea and great air-cells in the Trumpeter. This structure I shall fully explain, after a few remarks on the general appearance of the living bird.

The external appearance differs little from the concise descriptions given by Latham and Cuvier; but Latham's figure represents the bird much too erect; for it usually carried its neck arched below, and its shoulders elevated above the bend of the neck, something in the manner of a heron.

In the first specimen examined, I found the beak of a deep-brown colour, and the upper mandible a little shorter than the lower; but this was evidently the effect of a hurt it had received some time before. The beaks of the other two specimens were dark-brown, streaked with deep-green. The upper mandible projected beyond the lower about $\frac{1}{9}$th of an inch; it was arched and pointed, but the extremity was a little rounded, though with sharp edges. The nostrils are large, oval, pervious, and slightly covered above and behind by a blackish membrane. The eye is large, and of a clear bluish-black colour. Dr Latham describes the iris as of a luteous-brown, but in my specimens it was not so; the iris, in the living and in the recently dead bird, being with difficulty distinguishable from the pupil.

The shield of brilliant feathers on the breast was conspicuous in them all, though two were females; but the colour had more of the iridescent hues of tempered steel than of the golden tint described by some authors. The feathers of the head and neck are velvet-black, soft and curled; the feathers on the shoulders, and breast below the shield, are long, slender, and more coarse. The scapulars

descend considerably on the back, and near their extremities partake of that rufous ash colour which has been by some ornithologists termed *testaceous*.

The wings are short and concave. The spurious wing has four stout feathers. The primaries are 14, of a deep-brown colour, with blackish shafts; but they are nearly equalled by the ten secondary feathers, which are of a fine ash-grey, and, folding over the upper parts of the bird, give its back and rump this colour, when the wings are closed. The wing covers are black.

The tail is short, consisting of ten black feathers, the longest of which do not exceed four inches.

The feathers on the back, rump, and whole under parts of the bird, are black, long and narrow. The feathers descend on the legs to within 1½ inch of the tarsal joint, commonly called the knee of a bird.

The tarsus is long and slender; and the bone, though strong, breaks into many fragments when fractured. The legs and feet are covered by a dense skin, of a fine apple-green colour. The hind part of the tarsus is protected by large scales, which are clouded with deep brown spots. The inner toe is connected to the middle one, by a strong membrane extending to the first joint. The hind toe is rather small. The claws are blackish, incurved, compressed, and sharp; the middle one, which, measured along its curvature, is fully half an inch in length, is slightly grooved on the inside of its lower surface, and has a sharp edge.

The social habits of this bird made the living specimen a favourite with its owner. It often accompanied the different members of the family in their walks; and, if any one attempted to avoid it by running, it speedily overtook the fugitive, aiding the action of its long legs by flapping its wings. It would eat from the hand, and readily fed on bread, boiled potatoes, or seeds; but it seemed most eager

in its search after insects and worms. This occupation it pursued with such intensity, while the gardener was turning up the soil, as sometimes to endanger its head from the stroke of the spade. It delighted to wade in pools of water; and was often observed to plunge its head below the surface, seemingly in quest of prey.

Latham has placed the *Psophia* among the *Gallinacei*; but Cuvier, with greater propriety, has included it in his order of *Echassiers*, the *Grallæ* of Linnæus; to which the habits of the bird, and its external form (with the exception of its head), are more analogous. This idea acquires further confirmation from the very little fat between the skin and muscles of this bird, as well as the extreme difficulty I found in separating them. In all my specimens, though apparently healthy, there was no fat to be seen between the skin and muscles, except a very little about the rump; yet in two of them there was a considerable accumulation of fat among the intestines, shewing that they were not emaciated.

The gullet of the *Psophia* is strongly muscular; its gizzard small, muscular, and, when recent, its internal coat is rugous, and is lined with a grass-green viscid fluid. The liver is large, covering the greatest part of the other viscera. The intestines are cylindrical, and nearly equal the narrowest part of the gullet in diameter; the cloaca is but slightly dilated. The coats of the intestines are thick and strong; they come off at right angles from the middle of the right side of the gizzard. In the two females the oviducts were short; the ovaries distinct, but not developed.

The transparent partitions of the great air-cells are remarkably tough in this bird, and communicate with each other in the usual manner. The external surfaces of the lungs are perforated by holes visible to the naked eye, and pervious to air.

The very peculiar cry of this bird has long been known to naturalists. When caressed, the living individual, from which this description is taken, uttered a deep basso sound, which may be tolerably represented by the syllables *ouĭ, ouĭ, oūi*, and which seemed to proceed from the interior of its body. This cry was occasionally preceded by a shriller note, which appeared to proceed from the mouth; but it was almost always followed by the deep internal sound above mentioned, that may be considered as the ordinary voice of the bird. During its emission, the mandibles were slightly separated, and the muscles of the belly were observed to be thrown into strong action, though without any convulsive effort.

It can only be from inattention that any naturalist could describe the sounds as emitted *per anum*, an idea from which the bird has derived its absurd trivial name. This appellation I would propose to change for a more suitable name, viz. *Psophia loricata*, or *P. clypeata*, in allusion to the breastplate or shield of beautiful feathers, so conspicuous on this bird. The voice is formed within the body, and seems to proceed from its interior; so that the *Psophia* may be considered as a true *ventriloquist*.

Though the extraordinary sounds emitted by the Trumpeter have attracted notice, I am not aware that any anatomist has hitherto investigated the structure of its organs of voice. I therefore readily availed myself of the first opportunity of examining its internal structure, and have found my first observations confirmed, after the interval of a year, by two other dissections.

On carefully dividing the ribs, and raising up the sternum, the respiratory organs were exposed to view; and I soon perceived that the bronchial tubes, instead of being united all round to the lower end of the trachea, so as to form with it continuous tubes, had each a considerable

aperture on their approximate sides; which opening communicated directly with the great air-cells of the cavity containing the heart and other viscera of the bird.

This deviation from the usual structure is not very obvious to the eye, until the attachment of one of the bronchial tubes to the lungs is divided, and turned back; when the *septum* of the lower end of the trachea is distinctly seen, fringed with a firm but delicate membrane, which is quite separated from that forming the approximate sides of the bronchial tubes; and a probe can be at once passed into the bronchial tubes, without the rupture of any membrane. In dissecting the recent specimen, on 6th August 1825, when the lungs and bronchial tubes were still *in situ*, and merely exposed to view, I placed the whole under the surface of water; and on blowing into the trachea, the air was seen to pass through these openings on the inner sides of the bronchial tubes. A fine bristle, blunted at the extremity by burning, was introduced into these openings, and afterwards they were found sufficient to admit a large silver probe. On 13th August the specimen preserved in spirits was carefully opened, in the presence of Dr Williams, in a somewhat different manner. After exposing the inside of the thorax, the heart was dissected away, and the bronchial tubes remained in their natural situation. We found a small cell freely communicating with the great air-cells, formed by a transparent membrane stretched over the bronchial tubes; while through it we could distinctly perceive the patulous openings in the bronchial tubes, kept distended by the rings of these tubes, so as to receive a portion of either air or water passing from the trachea; as we ascertained by placing the whole in a basin with water.

It would not be easy to represent in a drawing these apertures in the natural position of the bronchial tubes; but their appearance, when the tubes and trachea are in-

PLATE XVII

Engd for the Wern. Mem. Vol. V.

Fig. 1.

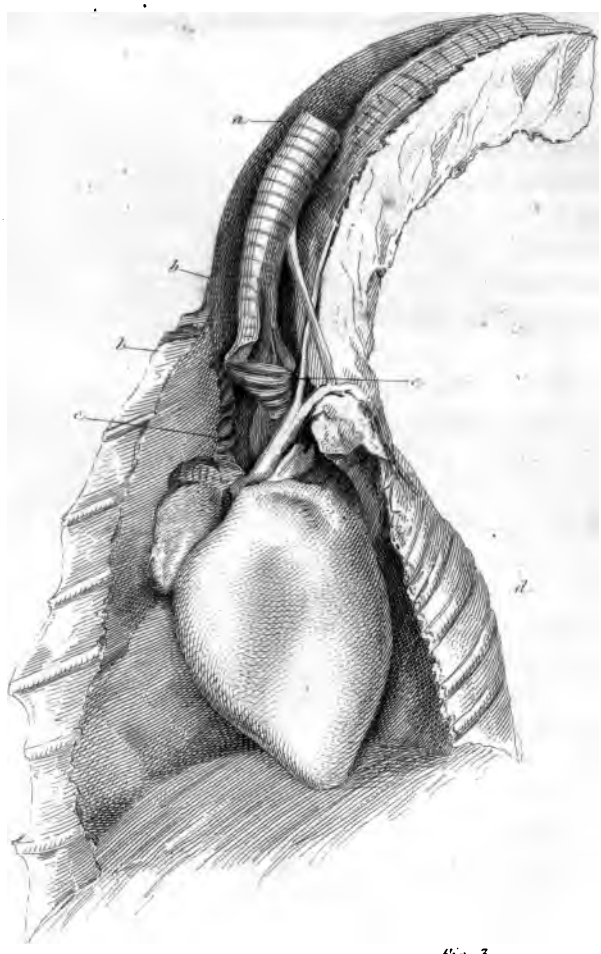
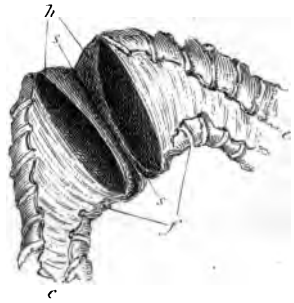


Fig. 2.

Fig. 3.



W.H. Lizars sc

verted, is shewn at Fig. 2., and still better at Fig. 3. Plate XVI. The drawing, Fig. 1., is of the size of nature; the parts are seen in their true position, having been taken while the subject was recent, and before the tubes were displaced.

The glottis or upper larynx of the Trumpeter presents nothing remarkable. The general form of the trachea is conical,—a shape (as remarked by Cuvier in his admirable Dissertation on the Voice of Birds) which is usually the index of an unmusical voice; whereas the cylindrical trachea belongs to songsters, and other birds possessing what he calls *une voix flutée*. The windpipe of the Trumpeter is very slightly dilated, about an inch before it enters the thorax, when it contracts a little, and rather suddenly. Each ring, when closely examined, consists of two cartilages joined firmly together at the sides of the trachea,—a structure not readily detected, until the windpipe has been macerated in water for some time. The rings are firm, and lie close to each other; yet the trachea is capable of considerable elongation, from the simultaneous action of the *mylo-hyoideus*, *sterno-trachealis*, and *upsilo-trachealis* muscles. On emerging from the thorax, the trachea first passes along the front, and then to the right side of the lower curvature of the neck, for about four inches; when it again stretches toward the forepart of the neck, before it reaches the head of the bird.

The lowest cartilage of the trachea is firm, almost bony; its lateral portions have an obtuse triangular form, with minute projections at the extremities, where they meet the bony septum of the lower larynx. This septum is thin, and about $\frac{1}{20}$th of an inch in depth, dividing the extremity of the air-tube into two acutely oval foramina, rather more than 0.3 inch in length, and 0.1 inch in their greatest diameter. Each side of the septum supports a thin, strong, membranous plate or fringe, about 0.1 inch in breadth,

which appears to be a continuation of the membrane lining the trachea; but which is quite divided from the membrane forming the approximate sides of the bronchial tubes *. The bronchial tubes have slender cartilages, that do not extend more than two-thirds around their circumference, even at their upper extremity. The approximate side of each tube, as is usually the case in birds, consists of a thin membrane, which is named by Cuvier *membrane tympaniforme;* but in the *Psophia* it can scarcely deserve that appellation, for, instead of uniting the trachea and bronchial tubes into continuous canals, as in other birds, the upper edge of the membrane forming the bronchial tubes is not continued to the end of the trachea, but allows an opening into each tube, sufficient to admit with ease a common probe,—by which a portion of the air passing from the trachea can find its way into the great air-cells, without previously passing through the lungs. The elasticity of the bronchial cartilages is sufficient to keep these openings so distended, that air at the same time passes into the lungs through the bronchial tubes: as may be seen in the preparation I have made of one of the birds.

It seems probable, from a consideration of the structure of the organs of voice and respiration in the Trumpeter, that the living bird has the power of regulating, in some degree, the relative quantity of air which shall pass in either direction, by the action of the *sterno-trachealis* and *upsilo-trachealis* muscles, aided by the contractility of a very minute pair of muscles (represented in Fig. 1. *b*, *b*), arising from the lower rings of the trachea, and inserted into the

* I may remark, that the whole lower larynx of the Trumpeter, with the exception of the apertures in the bronchial tubes, has a striking resemblance to the corresponding organs in the Whimbrel, *Scolopax phæopus*, a specimen of which I dissected about the same time as the first Trumpeter.

upper cartilage of the bronchial tubes. The bronchial tubes perforate the lungs in the usual manner; and the surface of the lungs exhibits to the eye numerous small perforations communicating with the great air-cells.

The extraordinary structure of the lower larynx in the *Psophia*, cannot fail to have much influence on its voice. The excellent description which Cuvier has given of the mechanism of the organs of voice in birds, and his very decisive experiments, leave it not doubtful that the lower larynx is the organ by which the sound is *produced*, although the modifications of its tone are influenced by the length and form of the trachea, and the contractions and dilatations of the upper larynx. The lower larynx may be considered, in relation to the organs of voice in birds, as the mouth-piece to the clarionet or flageolet,—the part where the sounds are *formed*; while the elongation of the trachea, or the contraction of the rima glottidis, merely vary the *intensity of the intonation*; just as lengthening a flute, by means of its sliding joint, deepens its tone; or as the hand of the player introduced into the expanded extremity of a French horn, affects the tension of the notes of that instrument.

In the bird now under consideration, the division of the aërial current must weaken its force, and the vibrations of the membranes of the lower larynx will therefore be less quickly performed, and, consequently, the voice of the bird reduced to a lower key, than if the current of air had acted in an undivided stream.

The ventriloquism of the *Psophia* appeared to me to be performed during *inspiration*; and it has been alleged, that persons who have acquired this curious faculty, utter their words during the act of receiving air into the lungs, whenever they wish to exhibit their art. The powerful

action of the muscles of the bird, when it uttered its peculiar cry, rendered it very difficult to ascertain this point with certainty; but it is not difficult to conceive how the voice, formed deeply within the body, would be materially affected by the direct communication of the windpipe with the great air-cells of this singular bird.

Description of the Drawing, Plate XVI.

Fig. 1. Opened thorax of the Trumpeter, of the natural size.

a, Dilated portion of the trachea.

b, *b*, A small muscle tending to draw up the bronchial tubes.

c, *c*, The bronchial tubes.

d, The heart *in situ*.

2. The inverted trachea and bronchial tubes, shewing the openings into the bronchial tubes.

3. Magnified view of the two bronchial tubes, *e*, *e*.

f, The membrane forming their approximate sides.

g, *g*, The bony septum dividing the lower part of the trachea.

h, The membranous plates which fringe the sides of the septum.

LIVERPOOL,
August 13. 1825.

XXXII.—*Memoir on the Classification and Division of* Gnaphalium *and* Xeranthemum *of* LINNÆUS.

By Mr DAVID DON,
Librarian to the Linnean Society, &c. &c.

IT must be admitted, that, notwithstanding the highly important labours of Brown, Cassini, Decandolle, and Kunth, much still remains to be done in the class of plants denominated *Compositæ*. In extensive genera, it very frequently happens, that numbers of species are included, having little affinity with those on which the genera were founded. This is eminently the case with *Gnaphalium* and *Xeranthemum*. We are not to be surprised, if our great master, LINNÆUS, has fallen sometimes into this error, —if we consider the scanty materials he had to work on, often being obliged to have recourse to figures, and these not the most faithful; but there is no reason why botanists should still continue these unnatural arrangements. The characters given by Linnæus himself of *Gnaphalium* and *Xeranthemum* will be found to apply to a few only of the species which have been referred to these two genera

The adoption by Willdenow of the genus *Elichrysum* of Tournefort, so far from lessening, only served to increase the confusion previously existing. Willdenow assumed, as the basis of his genus, an erroneous character, namely, "*receptaculum nudum*," which can only refer to a very small portion of his *Elichrysa*. Our distinguished countryman Mr Brown was the first to attempt a proper limitation of these genera, in a paper entitled, "Observations on the natural Family of Plants called *Compositæ*," inserted in the 12th volume of the Transactions of the Linnean Society. The reading of this admirable paper first led me to an examination of these genera, and the divisions I shall have to propose in the sequel, are the result of that investigation; but convinced that the subject is not yet exhausted, I give some of these divisions, with considerable diffidence, and I shall feel happy, if such of my botanical readers as possess the opportunities, will extend the research, and confirm the observations which I have made.

Before entering on the particular subject of this memoir, it will be perhaps advantageous to give some remarks illustrative of *Compositæ* in general. The *Compositæ* of all known families of plants are the most natural, and the most extensively distributed over the surface of the globe. In the Flora of almost every country, whether situate without or within the Tropics, they are found to constitute nearly a tenth of the Phænogamous Vegetation *. From this extensive distribution of the *Compositæ* has resulted the apparent necessity of dividing them into divers separate groups or families; and hence we find in the writings of the earliest systematic botanists, from Cæsalpinus down to the present time, that various attempts have been made to divide them.

* In tropical countries possessing great diversity of surface, such, for example, as South America, the proportion is considerably greater.

Even a superficial observer cannot but be struck with the apparent discrepancies between certain groups of the *Compositæ;* but let him examine these groups in detail, and these differences at once vanish: for in no class is a uniform chain of natural affinities so beautifully exemplified as in the *Compositæ*. Here we observe no breaks in the series of natural affinities. If interruptions, therefore, in the chain of affinities exist, and we know they do exist in other families, they are not to be found in this, where the various groups are so intimately connected, so blended together at their extremities, that it is next to impossible to define their limits. This is universally the case in all truly natural families. The more a family becomes known, the more difficulty attends its separation into groups.

The end of all divisions in extensive families being practical utility, it is not merely necessary to group together the various genera according to their respective affinities to a particular genus, which is assumed as the type of each separate group; but it is likewise necessary, in order to render such divisions subservient to practical use, that each group be limited by certain characters peculiar to each. Keeping this in view, therefore, we observe that, whatever divisions are adopted in the *Compositæ*, they can only, strictly speaking, be regarded as merely artificial. The important labours of M. Henri Cassini have thrown great light on this class of plants. If this distinguished botanist has erred, it is in forming too many divisions, and in separating genera, which nature evidently intended should not be disjoined. That *Gnaphalium*, which M. Cassini has placed among his *Inuleæ*, and *Xeranthemum*, of which the same distinguished botanist has constituted a distinct group, named by him *Xeranthemeæ*, possess all the essential characters of the *Carduaceæ*, must be evident to every one who has turned his attention to the subject. All of them possess tubular florets, bicaudate anthers,

alternate leaves, and a large proportion of them have a paleaceous receptacle, and the rays of the pappus connected at the base,—all of which appear incontestibly to prove that they cannot with propriety be removed from the *Carduaceæ;* but it is, however, to be observed, that the latter have the tube of their florets suddenly contracted from near the middle downwards; while in *Gnaphalium* and *Helichrysum*, and in the other genera which have been separated from them, the tube of the florets is nearly equal, or gradually narrowed downwards from the summit to the base, as in the *Carlineæ* of M. Cassini. This character, although perhaps of generic importance, cannot be assumed as the foundation of a separate group, being liable to considerable variation. Thus, for example, *Cnicus Acarna*, *Carduus cernuus* *, *Carthamus tinctorius*, and *Carduus uniflorus*, agree with the *Carlineæ* in the form of their florets; and in *Cnicus serratuloides*, *Carduus cyanoides* and *palustris*, the contraction of the tube is scarcely perceptible. In *Xeranthemum* and *Chardinia* the tube of the florets is widened towards the base, and contracted upwards. Had the form and structure of the stigmas in *Helichrysum*, *Gnaphalium*, &c. been uniformly constant, they would have assisted materially in distinguishing them as a separate group. The genus *Carlina* agrees in its stigma with *Xeranthemum*, and with *Astelma* of Brown, in having the rays of its feathery seed-crown united into bundles for a considerable way above the base. The similarity of the pappus of *Acarna* to that of *Metalasia*, is equally striking. In *Carlina acaulis* and *simplex*, as well as in *Atractylis gummifera*, which really belongs to *Carlina*, the rays of the pappus are so remarkably thickened at their extremi-

* This plant M. Cassini has constituted into a genus, named by him *Alfredia*, and has arranged it among the *Carlineæ*.

ties, that they might readily be mistaken for the stigmas, which are far less conspicuous. This is also the case with the *Carlina echinus*, the *Echinus mutans* of Cassini; but in it the rays of the pappus are unconnected at the base, and the figure of the florets, as in *Cnicus*, *Carduus*, &c. In the *Carlina vulgaris* and *corymbosa*, the rays of the pappus end in a naked thorny point. The *Inuleæ* of M. Cassini, limited to *Inula* and *Coryza*, will possess sufficient marks in their herbaceous involucrum, and in having ligulate florets in the ray, to keep them distinct. *Bupthalmum*, referred by M. Cassini to *Inuleæ*, belongs to the *Helianthecæ*, and *Carpesium* to the *Anthemoideæ*.

We have seen, therefore, the intimate affinity that exists between the true *Carduaceæ* and the plants referred to *Gnaphalium* and *Xeranthemum* of Linnæus. In comparing the *Eupatoreæ* of Cassini, to which the *Vernoniaceæ* of the same distinguished botanist must be reduced, with the *Carduaceæ*, we shall find the affinity almost equally intimate. The former group differs from the latter in the absence of setæ at the base of the anthers. In *Liatris* and *Pteronia*, which belong to the *Eupatoreæ*, the involucrum is analogous, especially in *Liatris elegans*, where it is furnished with long, lanceolate, acute, purple rays, like those of *Xeranthemum*. In *Liatris* also, the rays of the feathered seed-crown are united at the base; and both it and *Pteronia* have lanceolate stigmas analogous to those of some species of *Serratula*. If we turn our investigation to the *Labiatifloræ*, we shall meet with similar results. Let us compare, for example, *Xeranthemum*, in which the marginal florets are evidently bilabiate, the anthers bicaudate at the base, and we shall find how closely these characters bring it to the *Labiatifloræ* *. The genus *Catananche*, which belongs

* In some of the normal group of *Carduaceæ*, we find the limb of the florets irregular,—and in *Carduus Marianus*, the genus *Silybum* of Mænch, it is evidently bilabiate.

undoubtedly to the *Cichoraceæ*, agrees in every respect, both in habit and character, with *Xeranthemum*, except in the florets being all ligulate. The anthers, although not bicaudate at the base, cannot be regarded as entirely naked, being furnished with two small teeth. This is more distinctly observable in *Scolymus*, which, although belonging to the *Cichoraceæ*, has the habit of *Carlina*. The genus *Xeranthemum*, therefore, brings these three groups close to each other, as it were, at right angles.

Although divisions in the extensive class of *Compositæ* are absolutely necessary, in order to facilitate a knowledge of the genera of which it is composed, yet, by the foregoing remarks, I have endeavoured, and I trust satisfactorily, to shew that these divisions are to be regarded in no other light than as artificial; but although artificial, we must avoid the unnatural division of genera. Reserving to a future time the observations I have to make on the other groups of *Compositæ*, I shall now proceed to give characters of the genera I have to propose, adding at the end of each such remarks in elucidation as may appear necessary.

XERANTHEMUM, *Gærtn. Desf.*
XERANTHEMI sp. *Linn. Willd.*

Involucrum imbricatum, scariosum, coloratum; *squamis interioribus* simplici serie longè radiatis. *Receptaculum* planum: *paleis* distinctis, crebris, ensiformibus. *Flosculi hermaphroditi* tubulosi, 5-dentati basi dilatatâ coriaceâ; *fœminei* paucissimi in ambitu, tubo coriaceo, 5-fidi, bilabiati; *labio exteriore* bipartito, breviore. *Filamenta* omnino libera. *Antheræ* basi setis 2 plumosis instructæ. *Stigma* clavatum, emarginatum. *Achenia* oblonga, tereti-angulata, sericea; flosculis fœmineis glabra, apice calva. *Pappus* hermaphroditis hexaphyllus, paleaceus: *paleis* distinctis, ex ovatâ basi cuspidatis, serrulatis.

Herbæ (Europeæ) *erectæ, ramosæ, niveo-lanatæ, radice*

annua. Folia alterna, lanceolata, integerrima, uninervia. Flores solitarii, pedunculati, magni, albi v. rosei. Stigma flosculis fœmineis integrum, longè exsertum.

To this genus belong *Xeranthemum annuum* and *inapertum* of Willdenow, considered by Linnæus as varieties of one and the same species.

Although I have for the present followed the former, in regarding these as distinct, yet I am very much inclined to believe that they will be found to resolve into a single species. I have already pointed out the numerous points of agreement between this genus and *Catananche*, and that the stigma has a striking analogy to the same organ in *Carlina*, a circumstance which has been before observed by M. Cassini *. The tube of the florets in the *Carduaceæ* is in general of an uniform consistence; but in this and the following genus, the lower half of the tube is of a green colour, thick and coriaceous, and the upper half thin, and of a white colour. M. Desfontaines, although he notices it in *Chardinia*, does not seem to have been aware of its existence in this genus. Although apparently a character of considerable importance, M. Cassini does not notice it in his character of the tribe *Xeranthemeæ*.

CHARDINIA, *Desf.*
XERANTHEMI sp. *Willd.*

Involucrum imbricatum, scariosum, coloratum, non radians. *Receptaculum* planum: *paleis* distinctis, crebris, ensiformibus. *Flosculi hermaphroditi* tubulosi, 5-dentati: *tubus* ferè æqualis, ultra dimidium coriaceus; *fœminei* marginales, filiformes, tridentati. *Filamenta* parte coriaceâ tubi connata, ultrà eam libera ac monadelpha. *Antheræ* basi setis 2 plumosis instructæ. *Stigma* clavatum, bilobum.

* Journ. Phys. 82. p. 127.

Achenia difformia; flosculis hermaphroditis oblonga, teretia, sulcata, paleis pluribus (9–10) lanceolatis cuspidatis coronata; fœmineis obcordata, trialata, alis serratis mucronatis.

Herba (Orientalis) *lanata, ramosa, radice annuâ.* Folia *sparsa, elliptica, dentata.* Flores *magni, solitarii, pedunculati, albi.*

This genus consists of but a solitary species, namely, *C. Xeranthemoides* of Desfontaines, the *Xeranthemum orientale* of Willdenow, and the *Xeranthemum orientale, fructu maximo* of Tournefort. So little was it known to Linnæus, that he did not even allow it the rank of a species, being his variety γ of *Xeranthemum annuum.* Although these too genera have many points in common, yet they severally possess abundant characters to keep them distinct. The rayless involucrum, the form of the female florets and seeds, the stamens being united to the tube of the florets, and the polyphyllous pappus, are the distinguishing features of *Chardinia.* The genus was established by M. Desfontaines, who has given a very clear and satisfactory account of it, as well as of *Xeranthemum,* in the third volume of the "Memoires du Muséum d'Histoire Naturelle." The name is intended to commemorate the famous Chardin, celebrated for his travels in Persia; and therefore the old specific appellation *orientale* ought to be adopted, in preference to the one proposed by M. Desfontaines. The plant is a native of Armenia.

LEUCOSTEMMA.

ELICHRYSI sp. *Gærtn. Willd.*
XERANTHEMI sp. *Linn.*

Involucrum globosum, imbricatum, scariosum, coloratum: *squamis* omnibus subæqualibus, lanceolatis, acutis,

longè radiantibus. *Receptaculum* hemisphæricum: *paleis* distinctis, lanceolatis, mucronatis, crebris. *Flosculi* omnes hermaphroditi, tubulosi, 5-dentati. *Antheræ* setis 2 plumosis basi instructæ. *Stigma* bipartitum: *laciniis* linearibus, medio canaliculatis, apice incrassatis truncatisque. *Achenia* tetragona, papilloso-micantia. *Pappus* radiis capillaceis, basi in annulum connexis, apice incrassatis, denticulatis.

Frutices (Africæ australis) *densè niveo-lanati.* Folia *alterna, coriacea, marginata, sessilia.* Pedunculi *squamis scariosis niveis illarum involucri instar instructi.* Flores *terminales, solitarii, magni, speciosi, papyracei, nitidi.*

1. *L. vestitum,* foliis linearibus acutis.

Xeranthemum vestitum, Linn. Sp. Pl. 1201.
Gnaphalium vestitum, Thunb. Prod. 148.
Elichrysum vestitum, Willd. Sp. Pl. 3. p. 1903.

Hab. in Promontorio Bonæ Spei. *Thunberg, Masson, Labillardiere, Niven.* ♄. (v. v. c. et s. sp. in Herb. Lamb.)

2. *L. lingulatum,* foliis lingulatis obtusis.

Hab. in Promontorio Bonæ Spei. *Labillardiere.* ♄. (v. s. sp. in Herb. Lamb.)

Præcedenti affine, at foliis triplò latioribus differt.

This beautiful and very distinct genus agrees with the two preceding genera, in having the receptacle thickly beset with lanceolate, distinct, pointed paleæ; but its capillary pappus, its parted stigma, and the uniformity and texture of its florets, distinguish it essentially from both. The brilliant white heads of flowers has suggested the name of *Leucostemma,* which I have applied to the genus. It is derived from λευκος, *albus,* and στεμμα, *corona.*

ASTELMA, *Brown.*
GNAPHALII et XERANTHEMI sp. *Linn.*
ELICHRYSI sp. *Willd.*

Involucrum imbricatum, scariosum, coloratum, connivens v. radians. *Receptaculum* convexum, favosum v. subpaleatum. *Flosculi* omnes hermaphroditi, tubulosi, 5-dentati. *Antheræ* basi biplumatæ. *Stigma* bipartitum: *laciniis* lineari-lingulatis, obtusis. *Pappus* radiis plumosis, infernè connatis.

Frutices (Africæ australis) *densè niveo-lanati.* Folia *alterna, sessilia, integerrima, plana.* Flores *terminales, solitarii v. corymbosi, magni, speciosi, nivei v. purpureo-coccinei, aut aurei.*

* *Involucris conniventibus.*

1. *A. eximium,* foliis ovatis acutis, corymbo simplici multifloro, involucris globosis: *squamis* ovalibus obtusissimis.

Astelma eximium, Brown in Bot. Reg. t. 532.
Gnaphalium eximium, Linn. Mant. 573.—Willd. Sp. Pl. 3. p. 1849.

Hab. in Promontorio Bonæ Spei. *Edmundus Lambert, Niven, Joannes Roxburgh.* ♄. (v. v. c. et s. sp. in Herb. Lamb.)

Involucra globosa, purpureo-coccinea, nitida. *Receptaculum* favosum.

This plant, Mr Lambert informs me, flowered for the first time in England, at Mr Lee's, Hammersmith, in the year 1794.

2. *A. milleflorum,* foliis ovato-lanceolatis mucronatis, corymbis compositis patentissimis, involucris oblongis: *squamis* oblongis apice rotundatis.

Gnaphalium milleflorum, Linn. Suppl. 362. — Thunb. Prod. 152. — Willd. Sp. Pl. 3. p. 1860.

Hab. in planitie aridâ, ad ripas fluminis magni, in Promontorio Bonæ Spei. *Thunberg, Niven.* ♄. (v. s. sp. in Herb. Lamb.)

Planta 3–6-pedalis, ramosa, densè niveo-lanata. *Corymbus* amplus, indefinitè multiflorus. *Involucra* oblonga, nivea. *Receptaculum* maximè favosum.

3. *A. Stæhelina,* foliis lanceolatis basi attenuatis niveo-tomentosis, pedunculis elongatis solitariis nudiusculis, involucri squamis ellipticis obtusis.

Xeranthemum Stæhelina, Linn. Syst. Veg. 624.—Thunb. Prod. 153. Elichrysum Stæhelina, Willd. Sp. Pl. 3. p. 1910.

Hab. in Promontorio Bonæ Spei. *Thunberg, Labillardiere, Joannes Roxburgh.* ♄. (v. s. sp. in Herb. Lamb.)

Involucra oblonga, aurea. *Receptaculum* subpaleatum.

4. *A. crassifolium,* foliis ellipticis basi dilatatis niveo-tomentosis, pedunculis elongatis solitariis nudiusculis, involucri squamis rotundatis.

Hab. in Promontorio Bonæ Spei. *Niven, Joannes Roxburgh.* ♄. (v. s. sp. in Herb. Lamb.)

Præcedenti affine. *Receptaculum* etiam subpaleatum.

** *Involucris radiatis.*

5. *A. proteoides,* foliis lanceolatis uninerviis, floribus solitariis sessilibus, involucri squamis ovato-lanceolatis acutis.

Hab. in Promontorio Bonæ Spei. *Joannes Roxburgh.* ♄. (v. s. sp. in Herb. Lamb.)

Frutex facie omninò *Proteæ* v. *Leucadendri,* densè niveo-lanatus. *Folia* bi- v. tripollicaria. *Flores* magni, nivei

6. *A. speciosissimum*, foliis lanceolatis subtrinerviis, pedunculis elongatis solitariis nudiusculis, involucri squamis ovato-lanceolatis acuminatis.

Xeranthemum speciosissimum, Linn. Sp. Pl. 1202.—Thunb. Prod. 153.
Elichrysum speciosissimum, Willd. Sp. Pl. 3. p. 1904.

Hab. in Montis Tabularii locis glareosis ad Promontorium Bonæ Spei. *Thunberg, Menzies, Niven, Joannes Roxburgh.* ♄. (v. v. c. et s. sp. in Herb. Lamb.)

Flores maximi, nivei.

7. *A. lineare*, foliis linearibus uninerviis utrinque lutescente-lanatis, pedunculis elongatis solitariis nudiusculis, involucri squamis ovato-lanceolatis acutis.

Hab. ad Promontorium Bonæ Spei. *Joannes Roxburgh.* ♄. (v. s. sp. in Herb. Lamb.)

Præcedenti affine. *Flores* minores, nivei.

8. *A. variegatum*, foliis lanceolatis acutis carinatis laxissimè imbricatis sæpiùsque tortis margine apiceque rufis, pedunculis solitariis, involucri squamis oblongis obtusis apice extùs atro-sanguineis.

Xeranthemum variegatum, Linn. Syst. Veg. 624.—Thunb. Prod. 153.
Elichrysum variegatum, Willd. Sp. Pl. 3. p. 1911.
β spirale, floribus majoribus.
Elichrysum spirale, Andrew's Rep. t. 262.—Willd. Sp. Pl. 3. p. 1903.

Hab. in planitie sterili prope Caput Bonæ Spei. *Menzies, Niven, Joannes Roxburgh.* ♄. (v. v. c. et s. sp. in Herb. Lamb.)

Rami sæpè flexuosi. *Involucra* maxima, nivea, extùs præsertim apices squamarum versus atro-sanguinea. *Receptaculum* planum, favoso-paleaceum.

9. *A. imbricatum*, foliis lanceolatis imbricatis tomentosis, pedunculis solitariis squamosis, involucri squamis ovatis acuminatis.

Xeranthemum imbricatum, Linn. Amœn. Acad. 6. p. 100.—Thunb. Prod. 153.
Elichrysum imbricatum, Willd. Sp. Pl. 3. p. 1905.

Hab. ad Promontorium Bonæ Spei. *Thunberg, Labillardiere, Menzies, Joannes Roxburgh.* ♄. (v. s. sp. in Herb. Lamb.)

Involucra rosea. *Receptaculum* hemisphæricum, processibus numerosis, subcarnosis mollibus instructum.

10. *A. canescens*, foliis ovatis imbricatis tomentosis, pedunculis solitariis squamosis, involucri squamis ovatis acutis.

Xeranthemum canescens, Linn. Amœn. Acad. 6. p. 100.
Elichrysum canescens, Willd. Sp. Pl. 3. p. 1906.

Hab. in Promontorio Bonæ Spei. *Menzies, Joannes Roxburgh.* ♄. (v. s. sp. in Herb. Lamb.)

Receptaculum ut in præcedente, cui planta maxime affinis est.

Mr Brown first constituted as a distinct genus, under the name of *Astelma*, the *Gnaphalium eximium* of Linnæus; but as the character given by Mr Brown, in the Botanical Register, appears to be constructed solely from *eximium*, I have found it necessary to give a new one, in order to include *Gnaphalium milleflorum*, and several species of *Elichrysum*, which cannot be removed from this genus. The receptacle of *Astelma eximium* is by no means naked, but it is distinctly honey-combed; and the involucrum, in an advanced state, becomes radiant like the *A. variegatum*, although less decidedly so. There are many genera, which are truly natural, included in this family, which afford numerous instances, tending to shew that the involucrum, whether radiant or connivent, is not a character of generic importance in this tribe of plants. The fundamental character of *Astelma*, therefore, is to be found in the plumose

pappus, whose rays are united for a considerable way above the base, like that of *Carlina*, as we have already remarked. I have placed at the end of the species *A. imbricatum* and *canescens*, as they appear to form the link between *Astelma* and the following genus.

APHELEXIS.

XERANTHEMI sp. *Linn.*
ELICHRYSI sp. *Willd.*

Involucrum campanulatum, laxè imbricatum, scariosum, coloratum, longè radiatum. *Receptaculum* planum, crebrè paleaceum: *paleis* rigidis, mucronatis, simplicibus, aut bitripartitisve. *Flosculi* omnes hermaphroditi, tubulosi, 5-dentati. *Antheræ* basi biplumatæ. *Stigma* bipartitum: *laciniis* recurvatis, apice incrassatis truncatisque. *Pappi radiis* plumosis, basi connexis.

Suffrutices (Africæ australis) *ramosissimi*. Rami *virgati, filiformes, uniflori nivco-lanati*. Folia *acerosa, supra sulco exarata, nudiuscula, basi dilatata, sæpiùs imbricata*. Flores *solitarii, magni, nivei, purpurei v. sulphurei*.

1. *A. sesamoides*, foliis omnibus trigonis adpressis, floribus sessilibus, involucri squamis ovato-lanceolatis acutis, paleis linearibus simplicibus.

Xeranthemum sesamoides, Linn. Sp. Pl. 1203.—Thunb. Prod. 152.
Elichrysum sesamoides, Willd. Sp. Pl. 3. p. 1909.
β floribus purpureis.

Hab. ad Promontorium Bonæ Spei. *Thunberg, Masson, Niven, E. Lambert, Joannes Roxburgh.* ♄. (v. v. c. et s. sp. α et β in Herb. Lamb.)

Rami virgati, filiformes. *Flores* nivei, maximi.

2. *A. fasciculata*, foliis inferioribus filiformibus patulis;

rameis adpressis trigonis, pedunculis squamosis, involucri squamis ovato-lanceolatis acutis, paleis lanceolatis carinatis.

Xeranthemum fasciculatum, Andrew's Rep. t. 242.
Elichrysum fasciculatum, Willd. Sp. Pl. 3. p. 1909.
β floribus argenteis, Andr. l. c. t. 279.
γ floribus roseis.

Hab. in Promontorio Bonæ Spei. *Masson, Niven, Joannes Roxburgh.* ♄. (v. v. c. et s. sp. α, β, et γ, in Herb. Lamb.)

Rami virgati, filiformes. *Folia inferiora* patula, 2–3-pollicaria. *Flores* citrini. *Paleæ* simplices, aut bi- v. tripartitæ.

3. *A. filiformis*, foliis inferioribus filiformibus patulis; rameis adpressis trigonis, floribus subsessilibus, involucri squamis ellipticis obtusis, paleis lanceolatis carinatis.

Elichrysum filiforme, Hortulanis.
β floribus roseis.
γ floribus citrinis.

Hab. ad Promontorium Bonæ Spei. *Niven, Joannes Roxburgh.* ♄. (v. v. c. et s. sp. α, β et γ in Herb. Lamb.)

Rami virgati, filiformes. *Folia inferiora* patula, 3–4-pollicaria. *Flores* omnibus minores, argentei. *Paleæ* simplices v. divisæ.

4. *A. humilis*, foliis teretibus erecto-patulis rigidis basi latè dilatatis, pedunculis squamosis, involucri squamis ovatis acutis, receptaculo faveso.

Elichrysum humile, Andrew's Rep. t. 652,
β floribus niveis.

Hab. in Promontorio Bonæ Spei. *Masson, Labillardiere, Niven.* ♄. (v. v. c. et s. sp. α et β in Herb. Lamb.)

Frutex humilior, rigidior. *Folia* breviora ac latiora, rigida, erecto-patula. *Flores* rosei, speciosi.

The peculiar habit of the species which compose this genus, would seem of itself sufficient to warrant its separation from the preceding. The shortness of the florets, when compared with the length of the scales, composing the bell-shaped involucrum, and the receptacle being beset with rigid, pointed paleæ, will serve to confirm the separation. The rays of the seed-crown are merely united at the base. The colour of the involucrum varies in the different species from white to purple and yellow. The generic name, which is intended to denote the remarkable simplicity of form observable in all the species of this genus, I have derived from ἁφιλης, *simplex*, and ἕξις, *habitus*.

EUCHLORIS.

GNAPHALII sp. *Linn.*

Involucrum subrotundum, imbricatum, scariosum, coloratum, connivens: *squamis* rotundo-ovalibus, membranaceis. *Receptaculum* paleis angulatis, retusis, rigidis, in conum conniventibus, basi coalitis crebrè tectum. *Flosculi* omnes hermaphroditi, tubulosi, 5-dentati. *Antheræ* basi biplumatæ. *Stigma* bipartitum: *laciniis* linearibus, truncatis. *Pappi radiis* basi connexis, apice peniculatis.

Herba (Africæ australis) *perennis, sempervirens, nuda.* Caulis *erectus, simplex, firmus, teres, supernè aphyllus, sesquipedalis.* Folia *elliptico-oblonga, obtusa, 5-nervia, integerrima, utrinque nuda, viridia, coriacea, 3–4-pollicaria, petiolata;* caulina *amplexicaulia.* Flores *terminales, numerosissimi, compositè corymbosi, magnitudine* Antennariæ margaritaceæ, *nivei.*

1. *E. nudifolia.*

Gnaphalium nudifolium, *Linn.*

Hab. in Promontorio Bonæ Spei., *Roxburgh.* ♃. (v. s. sp. in Herb. Lamb.)

This plant is perfectly green, and entirely destitute of the woolliness so peculiar to this tribe of plants. The form and disposition of the paleæ are sufficient to distinguish it. The pappus resembles very much in structure that of the male of *Leontopodium*, and of some species of *Antennaria*. The generic name alludes to the smooth and green appearance of the plant, and is derived from *εὐ*, *bellè*, and *χλωρὸς*, *viridis*.

HELICHRYSUM.

Elichrysi et Gnaphalii sp. *Willd.*

Involucrum imbricatum, scariosum, coloratum, connivens v. radiatum. *Receptaculum* nudum. *Flosculi* omnes hermaphroditi, tubulosi, 5-dentati. *Antheræ* basi bipluматæ. *Stigma* bipartitum: *laciniis* linearibus, apice incrassatis truncatisque. *Pappi radiis* capillaceis denticulatis v. apice peniculatis, basi connexis v. solutis.

Herbæ v. Frutices (Asiæ, Africæ et Americæ) *plerumque niveo-tomentosi*. Folia *alterna, sessilia, patula*. Flores *terminales, solitarii v. corymbosi, aurei, rosei, aut nivei*.

The genus *Helichrysum*, as here limited, is distinguished by a naked receptacle, and a capillary seed-crown. It will thus include a large proportion of the Linnæan *Gnaphalia*. In my *Prodromus Florœ Nepalensis*, I had inadvertently united with this genus the *Astelma* of Brown, although the character there given could not include the latter genus. In several species belonging to *Helichrysum* we find the pappus has a striking analogy to the male pappus of *Leontopodium*, and to some species of *Antennaria*. I have followed Persoon in restoring the aspiration to the name; *Elichrysum*, adopted by Willdenow, being contrary to analogy. The following are the species belonging to this genus, viz.

Elichrysum fulgidum Willd., *bellidioides* Willd., *dealbatum* and *scorpioides* Labill., *bracteatum* and *rigidum* Andr., *Helichrysum stoloniferum* and *elegans* Prod. Fl. Nep., *Gnaphalium arboreum* L., *grandiflorum* L., *fruticans* L., *congestum* L., *patulum* L., *ignescens* L., *Stœchas* L., *petiolatum* L., *crassifolium* L., *capitellatum* Thunb., *orientale* L., *arenarium* L., *lavendulæfolium* Willd., *rutilans* L., *cymosum* L., *apiculatum* Labill. These are all of the published species I have yet determined, owing to the vagueness of the descriptions given by authors, and the want of good figures to determine precisely the plants they intend. There are, besides, a great number of unpublished species from New Holland and the Cape of Good Hope.

PENTATAXIS.

Involucrum oblongum, pauciflosculosum, pentagonum: *squamis* coloratis, obtusis, adpressè 5-fariam imbricatis, supra torum brevem digestis. *Receptaculum* parvum, favosum. *Flosculi* 5, hermaphroditi, tubulosi, 5-dentati. *Antheræ* basi biplumatæ. *Stigma* bifidum, inclusum: *laciniis* semicylindricis, truncatis. *Pappus* capillaris, serrulatus: *radiis* basi connexis.

Suffrutex (Africæ australis) *erectus, ramosus, niveo-lanatus.* Rami *elongati.* Folia *alterna, lanceolata, acuta, amplexicaulia, margine integerrima, crispata.* Corymbus *compositus, glomeratus,* Achyranthis *facie.* Flores *parvi, nivei.*

1. *P. micrantha.*

Hab. in Promontorio Bonæ Spei. *Labillardiere.* ħ. (v. s. sp. in Herb. Lamb.)

This genus is closely allied, both in habit and character, to *Cassinia* of Brown, a genus peculiar to New Holland and New Zealand. It differs, however, in having a honeycombed receptacle, which in *Cassinia* is clothed with paleæ, resembling the inner scales of the involucrum. In Mr Brown's *Ozothamnus*, a genus very nearly related both to *Cassinia* and *Pentataxis*, the receptacle is quite naked. The curious arrangement of the scales of the involucrum in our genus is also found in *Cassinia quinquefaria* of Brown, and there the scales are likewise disposed in five series. To this curious disposition of the scales of the involucrum, the name I have given is intended to apply. It is composed of πεντε, *quinque*, and ταξις, *series*.

SPIRALEPIS.

GNAPHALII sp. *Thunb., Willd.*

Involucrum polyphyllum, imbricatum; *squamis interioribus* in acumen longum subulatum recurvato-tortuosum canaliculatum desinentibus, et radium revolutum, coloratum efformantibus. *Receptaculum* parvum, nudum, scrobiculatum. *Flosculi* omnes hermaphroditi, tubulosi, 5-dentati. *Antheræ* basi biplumatæ. *Stigma* bipartitum: *laciniis* apice incrassatis truncatisque. *Pappus* capillaris, niveus, denticulatus, persistens: *radiis* basi solutis.

Herbæ (Africæ australis) *perennes, procumbentes, ramosæ, niveo-lanatæ*. Folia *alterna, sessilia, integerrima*. Flores *glomerati, bracteati, albi, rosei v. purpurei*.

1. *S. squarrosa*, foliis lingulatis obtusis, capitulis congestis multifloris, caule assurgente.

Gnaphalium squarrosum, Linn. Sp. Pl. 1197.—Thunb. Prod. 151.—Jacq. Fragm. p. 6. t. 3. f. 4. (bona).—Willd. Sp. Pl. 3. p. 1877.

Hab. in Promontorio Bonæ Spei. *Thunberg, Joannes Roxburgh.* ♃. (v. s. sp. in Herb. Lamb.)

2. *S. glomerata*, foliis spathulatis petiolatis, capitulis foliosis, caule diffuso: ramis elongatis.

Gnaphalium glomeratum, Linn. Amœn. Acad. 6. p. 99.—Thunb. Prod. 151.—Willd. Sp. Pl. 3. p. 1891.

Hab. in planitie arida prope Caput Bonæ Spei. *Thunberg, Niven.* ♃. (v. s. sp. in Herb. Lamb.)

3. *S. tincta*, foliis cuneato-rotundatis, capitulis paucifloris, caule prostrato radicante.

Gnaphalium tinctum, Thunb. Prod. 151.—Willd. Sp. Pl. 3. p. 1877.

Hab. ad Promontorium Bonæ Spei. *Labillardiere.* ♃. (v. s. sp. in Herb. Lamb.)

4. *S. rotundifolia*, foliis cuneato-rotundatis rugosissimis, capitulis globosis, caule procumbente.

Gnaphalium rotundifolium, Thunb. Prod. 152.—Willd. l. c. 3. p. 1901.

Hab. in Capite Bonæ Spei. *J. Roxburgh.* ♃. (v. s. sp in Herb. Lamb.)

I have separated this genus from *Helichrysum*, on account of the peculiar structure of its involucrum, whose scales are nearly of equal length, and terminated by a long twisted point, to which the generic name alludes. The species agree so well in habit and character, that, although perfectly distinct, they are with difficulty characterised, so as to be easily known. The generic name is composed of σπειρα, *spira*, and λεπις, *squama*.

PETALACTE.

GNAPHALII sp. *Linn., Willd.*

Involucrum cylindraceum, simplici serie polyphyllum: *foliolis* linearibus, distinctis, æqualibus, apice laminâ petaloideâ orbiculatâ scariosâ coloratâ patulâ radiatis. *Recepta-*

culum parvum, favosum. *Flosculi* omnes hermaphroditi, tubulosi, 5-dentati. *Antheræ* basi bisetæ: *setis* obtusis, nudis. *Stigmata* linearia, truncata. *Pappus* niveus, caducus: *radiis* basi solutis, apice penicillatis.

Frutices (Africæ australis) *humiles, lanati, erecti.* Folia *sparsa, mucronulata, integerrima, sessilia, coriacea.* Flores *terminales, fasciculato-corymbosi, pulchri, albi aut purpurei.*

1. *P. coronata,* foliis lanceolatis, radio concolori.

Gnaphalium coronatum, Linn. Sp. Pl. 1191.—Thunb. Prod. 149.—Willd. l. c. 3. p. 1854.

Hab. ad Promontorium Bonæ Spei, in declivitate Montis Tabularii. *Niven, Joannes Roxburgh.* ♄. Floret Octobri et Novembri. (v. s. sp. in Herb. Lamb.)

Fruticulus cæspitosus, palmaris. *Flores* fasciculatim corymbosi: *radio* niveo.

2. *P. bicolor,* foliis spathulatis, radio bicolori.

Hab. in Capite Bonæ Spei. *J. Roxburgh.* ♄. (v. s. sp. in Herb. Lamb.)

Præcedenti similis. *Involucri radius* purpureus et niveus.

The genus *Petalacte* is essentially distinguished by having a simple involucrum, whose leafits are of equal length, and furnished at the top with a broad, orbicular, coloured lamina, which give the flowers some distant resemblance to those of *Achillea Ptarmica.* The pappus is caducous, with the rays unconnected at the base. The setæ at the base of the anthers are naked and obtuse. The name alludes to the petaliform rays of the involucrum, and is derived from πετηλα, *petalum,* and ακτη, *radius.*

PHÆNOCOMA.

ELICHRYSI sp. *Willd.*
XERANTHEMI sp. *Linn.*

Involucrum globosum: *squamis* lanceolatis, mucronatis, basi adpressis; *interioribus* multiplici serie radiatis, longis, erectis, coloratis. *Receptaculum* conicum, nudum. *Flosculi fœminei* marginales, filiformi-tubulosi, fauce coarctati, obtusè 5-dentati, rudimentis staminum nullis; *masculi* numerosissimi, tubulosi, supra medium ventricosi, fauce coarctatâ, obtusè 5-dentati. *Antheræ* basi bisetosæ: *setis* tenuissimis, nudis. *Stigma* masculis inclusum, indivisum, truncatum; fœmineis bipartitum, exsertum: *laciniis* linearibus recurvatis, truncatis emarginatisque. *Achenia* difformia; fœmineis ovali-oblonga, undique villosissima; masculis linearia, glabra. *Pappus* uniformis: *radiis* apice peniculatis, basi levitèr connexis.

Frutex *habitu anomalus, erectus, rigidissimus, proliferè ramosissimus, lanugine niveâ appressâ tectus.* Ramuli *foliiferi, brevissimi* (*nunc semiunciales*) *conferti, patuli.* Folia *minuta, granulata, adpressè 5-fariam imbricata, nuda, nitida.* Flores *magni, terminales, solitarii, sessiles, purpureo-coccinei, splendidissimi.*

1. *P. prolifera.*

Xeranthemum proliferum, Linn. Sp. Pl. p. 1202.—Thunb. Prod. 152.
Elichrysum proliferum, Willd. Sp. Pl. 3. p. 1905.

Hab. ad Promontorium Bonæ Spei. *Thunberg, Masson, Labillardiere, Niven.* ♄. (v. v. c. et s. sp. in Herb. Lamb.)

This is one of the most splendid plants that can well be imagined. Its anomalous and almost leafless habit, and its large magnificent flowers, form a striking object. It could not therefore fail to attract the attention of the earliest

voyagers to the Cape of Good Hope; but, although it has been so long known to botanists, there are few plants that have been less understood than it. The female florets being five-toothed and tubular, and the naked slender setæ at the base of the anthers, together with the uniformity of the pappus in both the male and female florets, as well as the naked conical receptacle, will serve at once to distinguish it. This genus agrees in several respects with *Xeranthemum*. The name is derived from φαυος, *splendidus*, and κομη, *coma*, and is intended to denote its brilliant coloured involucrum.

CARPHOLOMA.

Involucrum oblongum, cylindraceum, imbricatum, lanatum, nec scariosum, nec radiatum: *squamis* adpressis, apice spinosis, patulis. *Receptaculum* planum, in peripheriâ solâ paleis distinctis setaceis instructum. *Flosculi* omnes hermaphroditi, tubulosi, 5-dentati. *Antheræ* basi bisetæ: *setis* puberulis. *Stigma* bipartitum: *laciniis* angustis, apice incrassatis truncatisque. *Pappus* pilosus, serrulatus: *radiis* basi fasciculatim connexis.

Frutex (Africæ australis) *erectus, rigidus, ramosissimus, niveo-lanatus*. Folia *fasciculata, brevia, teretiuscula, obtusa*. Flores *terminales, solitarii, purpurascentes*.

1. *C. rigidum*.

Hab. in Promontorio Bonæ Spei. *Labillardiere*. ♄. (v. s. sp. in Herb. Lamb.)

This is a very distinct and well-marked genus, on account of its spinose, truncate involucrum, which is neither scariose nor coloured, and flat receptacle, whose circumference is furnished with several slender paleæ. The resemblance between the involucrum of our plant and that of the true

Carduaceæ, is another proof in support of the opinions I have advanced in the preface. We have here the involucrum of the *Carduaceæ* united with the florets and truncated stigmas of *Gnaphalium*. The name is derived from *παφος*, *palea*, and *λωμα*, *margo*, in allusion to the paleaceous margin of the receptacle.

METALASIA, *Brown.*
ANTENNARIÆ sp. *Gærtn.*
GNAPHALII sp. *Linn., Willd.*

Involucrum cylindraceum, adpressè imbricatum: *squamis intimis* scariosis, coloratis, sæpè radiatis. *Receptaculum* minutum, scrobiculatum. *Flosculi* omnes hermaphroditi, tubulosi, 5-dentati. *Antheræ* basi biplumatæ. *Stigma* bipartitum: *laciniis* apice incrassatis truncatisque. *Pappi radiis* basi solutis, setaceis v. plerumque subulatis, planis, supernè dilatatis, margine tenuissimè serrulatis.

Frutices (Africæ australis) *aridi, rigidi, facie sæpè juniperinâ, ramosissimi.* Folia *sparsa v. fasciculata, rigida, plerumque tortuosa, quasi resupinata, pungenti-mucronata.* Flores *terminales, glomerati v. solitarii, albi, rosei, aut aurei.*

* *Foliis fasciculatis tortis, quasi resupinatis.*

1. *M. umbellata*, foliis ovato-lanceolatis subulatisve mucronatis patulis, floribus aggregatis sessilibus fastigiatis lanatis, involucri radiis intimis ovalibus obtusis integris, pappo subulato acuto.

Gnaphalium umbellatum, Linn. Suppl. 363.—Thunb. Prod. 147.—Willd. Sp. Pl. 3. p. 1861.

Hab. in Capite Bonæ Spei. *Thunberg, Masson.* ♄. (v. sp. in Herb. Lamb.)

Frutex rigidissimus, divaricato-ramosissimus: *ramis* di-

chotomis. *Folia primaria* ovato-lanceolata; *fasciculorum* subulata. *Involucri squamis* roseis.

2. *M. muricata*, foliis lineari-subulatis pungentibus deflexis, involucri radiis intimis ovalibus obsoletè 3-dentatis, pappo subulato obtuso.

Gnaphalium muricatum, Linn. Sp. Pl. 1192.—Thunb. Prod. 148.—Willd. Sp. Pl. 3. p. 1856.

Hab. in Capite Bonæ Spei. *Thunberg*, *Labillardiere*. ♄. (v. s. sp. in Herb. Lamb.)

Folia duplò longiora quàm in præcedente.

3. *M. divergens*, foliis lineari-lanceolatis pungentibus deflexis, floribus aggregatis sessilibus, radiis intimis involucri lanceolatis acutis, pappo subulato obtuso.

Gnaphalium divergens, Thunb. Prod. 148.—Willd. Sp. Pl. 3. p. 1857.

Hab. in Capite Bonæ Spei. *Thunberg*, *Labillardiere*. ♄. (v. s. sp. in Herb. Lamb.)

Folia uncialia. *Capitula* minora.

4. *M. fasciculata*, foliis lineari-lanceolatis mucronatis, corymbo composito patulo, radiis involucri lanceolatis apice dentatis, pappo subulato, ramis erectis fastigiatis.

Gnaphalium fasciculatum, Thunb. Prod. 148.—Willd. Sp. Pl. 3. p. 1858.

Hab. in Capite Bonæ Spei. *Thunberg*, *Labillardiere*. ♄. (v. s. sp. in Herb. Lamb.)

5. *M. fastigiata*, foliis lanceolatis mucronatis, corymbo composito patulo, radiis involucri lanceolatis mucronatis, pappo subulato, ramis patulis.

Gnaphalium fastigiatum, Thunb. Prod. 148.—Willd. Sp. Pl. 3. p. 1859.

Hab. ad Caput Bonæ Spei. *Thunberg*. ♄. (v. s. sp. in Herb. Lamb.)

6. *M. aurea*, foliis subulatis pungentibus, capitulis corymbosis fastigiatis, involucri squamis intimis rotundatis disco æqualibus, pappo subulato obtuso.

Hab. in planitie aridâ ad Promontorium Bonæ Spei juxta ripas fluminis Camtas dicti. *Niven.* ♄. (v. s. sp. in Herb. Lamb.)

Frutex 4-pedalis, rigidissimus. *Flores* aurei. *Involucra* cylindrica, semiuncialia.

7. *M. hispida*, foliis lineari-subulatis mucronatis ciliato-hispidis, capitulis aggregatis subsessilibus, involucri radiis oblongis obtusis.

Gnaphalium hispidum, Linn. Suppl. 363.—Thunb. Prod. 148.—Willd. Sp. Pl. 3. p. 1857.

Hab. ad Caput Bonæ Spei. *Thunberg.* ♄.

8. *M. polyanthos*, foliis lineari-subulatis mucronatis, corymbo composito paniculato, radiis involucri lanceolatis acutis.

Gnaphalium polyanthos, Thunb. Prod. 147.—Willd. Sp. Pl. 3. p. 1859.

Hab. in Capite Bonæ Spei. *Thunberg.* ♄.

9. *M. seriphioides*, foliis lineari-subulatis inermibus, floribus lateralibus sessilibus.

Gnaphalium seriphioides, Berg. cap. 267. (exclus. synon.)—Thunb. Prod. 148.—Willd. Sp. Pl. 3. p. 1860.

Hab. in Promontorio Bonæ Spei. *Thunberg.* ♄.

** *Foliis solitariis strictis, nec resupinatis.*

10. *M. pungens*, foliis ovato-lanceolatis mucronatis laxè quadrifariam imbricatis, umbellis capitatis, involucri radiis ovatis mucronatis, pappo subulato obtusiusculo.

Hab. ad Promontorium Bonæ Spei. *Niven.* ♄. (v. s. sp. in Herb. Lamb.)

11. *M. uniflora*, foliis ovatis mucronatis laxè quadrifariam imbricatis, floribus subsolitariis, involucri radiis lanceolatis mucronatis, pappo setaceo colorato basi coalito.

Hab. ad Caput Bonæ Spei. *Labillardiere.* ♄. (v. s. sp. in Herb. Lamb.)

Frutex erectus, rigidus, *Diosmæ imbricatæ* facie. *Flores* 5-plò omnibus majores, radio niveo.

12. *M. phylicoides*, foliis ovali-oblongis obtusè mucronulatis villosis 4-fariam imbricatis subtùs concavis, capitulis globosis, involucri radiis ovalibus obtusis, pappo capillari basi soluto.

Gnaphalium phylicoides, Niven MSS.

Hab. ad Promontorium Bonæ Spei, in locis siccis elevatis. *Niven.* ♄. (v. s. sp. in Herb. Lamb.)

Frutex pedalis, erectus, rigidus, *Phylicæ* facie. *Flores* capitati, radio niveo.

The genus *Metalasia* was separated by Mr Brown* from *Antennaria*, in which it had been included by Gærtner. Its habit and character are so widely different from *Antennaria*, as limited by Mr Brown, that we are surprised so distinguished a botanist as Gærtner should have united them. The leaves of most of the species of this genus are convex and smooth underneath, and concave and woolly on the upper surface, but by a peculiar twisting they become as if resupinate. That it is the upper surface which is concave and woolly, and not the under, will be at once seen, by examining the situation of the young leaves. In *M. pungens* the leaves have no twisting, and there the natural position of the leaves is evident.

* Linn. Trans. vol. 12, p. 122.

I have placed at the end two doubtful species, namely, *M. uniflora* and *phylicoides*, both of which differ very materially from the other species in the structure of their pappus. The former has leaves very similar to those of *M. pungens*, and agreeing with them also in their position; but the latter has the leaves truly concave on the under surface, and convex above.

ANTENNARIA, *Brown.*
ANTENNARIÆ sp. *Gærtn.*
GNAPHALII sp. *Linn.*

Involucrum polyphyllum, imbricatum, scariosum, coloratum; fœmineis connivens. *Receptaculum* planum, epaleatum, scrobiculatum. *Flosculi* dioici; *masculi* tubulosi, 5-dentati; *fœminei* tenuissimi, filiformes: *limbo* minuto, obliquo, 8-denticulato. *Antheræ* basi biplumatæ. *Stigma* exsertum, bipartitum laciniis obtusis; masculis inclusum, indivisum. *Pappus* difformis; *masculus* radiis apice v. incrassatis planis v. peniculatis; *fœmineus* capillaris, denticulatus, involucro multò longior, penicillatus.

Herbæ *perennes, cæspitosæ, niveo-lanatæ;* masculinæ *longè robustiores ac pulchriores.* Caules *simplices.* Folia *alterna, sessilia, integerrima, sæpè basi decurrentia;* radicalia *sæpè maxima, patentia.* Flores *terminales, corymbosi, albi v. rariùs rosei.* Prod. Fl. Nepal. p. 174. (charactere paulo mutato.)

There are several remarkable peculiarities relating to the flowers of the different sexes, some of which appear to me not to have been before remarked. The first is, that the involucra of the male flowers, those most frequently described, are more highly coloured, generally spherical, with the scales broad, obtuse, loosely imbricated or spreading, the innermost ones forming a ray considerably longer than the florets and pappus. The florets are also shorter than the pappus,

the rays of which are spreading. In the second place, the female involucra, on the contrary, are longer, cylindrical, with elongated, adpressed, mostly pointed, scales, the innermost series connivent, and shorter than the pappus, which is closely pressed together, and has a striking resemblance to a camel-hair-pencil. The circumstance of the scales of the female involucrum being uniformly longer, and generally pointed, has given rise to frequent mistakes in characterising the species. In the common *Antennaria dioica* the scales of the male involucrum are broad and rounded, while those of the female are lanceolate and pointed. The same will be found to be the case with the *Antennaria alpina*, the female of which has always been described. There are specimens both of the male and female of this plant in the herbarium of the late Earl of Bute, now in Mr Lambert's possession. They were collected on the Swiss Alps by M. Garcin. The pappus appears to me to afford the most satisfactory specific characters.

LEONTOPODIUM, *Brown.*
ANTENNARIÆ sp. *Gœrtn.*
GNAPHALII sp. *Linn.*

Involucrum hemisphæricum, imbricatum, lanosum, truncatum: *squamis* apice sphacelatis. *Receptaculum* planum, favosum. *Flosculi* polygami; *masculi* tubulosi, 5-dentati; *fœminei* filiformes: *limbo* obliquo, 3-denato. *Antheræ* basi setis 2, tenuissimis nudis instructæ. *Stigma* fœmineis bipartitum exsertum: *laciniis* linearibus, obtusis. *Pappus* difformis, basi connexis; *masculus* densissimus radiis apice peniculatis, involucro æqualibus, quasi truncatis; *fœmineus* capillaris, denticulatus, involucro vix longior.

Herbæ *perennes, densè niveo-lanatæ, cæspitosæ.* Folia *alterna, integerrima*; radicalibus *maximis.* Flores *termi-*

nales, numerosi, in capitulum planum collocati, sessiles, bracteis numerosis lanceolatis lanosis radiatim patulis involucrati. Involucra centralia *sæpiùs mascula.* Flosculi *masculi fœmineis v. neutris, et fœminei masculis intermixti.*

1. *L. alpinum*, capitulis solitariis sessilibus.

Gnaphalium Leontopodium, Lam. Encycl. 2. p. 751.—Scop. Carn. 2. p. 150.—Jacq. Austr. 1. t. 86.—Willd. Sp. Pl. 3. p. 1892.
Filago Leontopodium, Linn. Sp. Pl. 1312.

Hab. in Alpibus Helveticis, Austriacis, Valeriacis, Carinthiacis, et Delphinatus. ♃. (v. s. sp. in Herb. illustriss. Comitis de Bute, nunc in Mus. Lamb.)

2. *L. sibiricum*, capitulis pluribus pedunculatis.

Gnaphalium Leontopodioides, Willd. Sp. Pl. 3. p. 1893.
Filago Leontopodium, Pallas MSS.

Hab. in Sibiriâ orientali, ubi legit ann. 1789. *D. Merk.* ♃. (v. s. sp. in Herb. Pallas. nunc in Mus. Lamb.)

Caulis altior. *Folia* radicalia lanceolata, petiolata. *Capitula* plura, pedunculata.

In my 'Prodromus Floræ Nepalensis,' I had proposed to unite this genus to *Gnaphalium*, although it would certainly have been much more natural to have placed it with *Antennaria*, in which it had been included by Gærtner. The truncate polygamous flowers, the hemispherical, non-scariose, rayless involucrum, and the simple setæ at the base of the anthers, alone distinguish it from *Antennaria*; but as these characters, joined to the remarkable bracteæ, appear to warrant such a separation, I have willingly followed Mr Brown in the expediency of keeping them distinct. Both species are polygamous; that is, they have either separate stalks bearing male and female heads of flowers from the same root, or the centre involucrum in each head is male, and surrounded by several female ones. The female involucra are constantly furnished with some male florets, and the male involucra with either female, or neuter ones.

GNAPHALIUM, *Brown.*
GNAPHALII sp. *Linn.*

Involucrum polyphyllum, imbricatum, scariosum, coloratum, connivens. *Receptaculum* planum, nudum (rarò favosum). *Flosculi marginales* fœminei, numerosi, filiformes, tenuissimi: *limbo* minuto, obliquo, 3-denticulato; *centrales* masculi, pauci, tubulosi, 5-dentati. *Antheræ* coalitæ, basi bisetosæ. *Stigma* bifidum, in *masculis* inclusum, ac incompletum. *Pappus* tenuissimus, capillaris, denticulatus, utriusque sexus consimilis.

Herbæ (*pleræque annuæ et extra tropicos*), *humiles, ramosæ, niveo-lanatæ.* Folia *alterna, sessilia, integra.* Flores *terminales, corymbosi v. glomerati, albi aut aurei.* Prod. Fl. Nepal. 172.

The genus *Gnaphalium*, as now limited, forms a very natural and distinct group. It is abundantly characterised by having its male and female florets in the same involucrum, and by the uniformity of its pappus in both sexes. In the structure of its flowers, *Gnaphalium* has a striking analogy to *Erigeron*, as constituted by me in the 'Prodromus Floræ Nepalensis;' but the latter differs essentially in the anthers being destitute of setæ at their base. This genus forms, through the *Conyzeæ*, the transition to the *Astereæ*, the family to which *Erigeron* belongs. The species belonging to this genus are, *Gnaphalium germanicum* Sm., *arvense* Willd., *montanum* Willd., *gallicum* Sm., *pyramidatum* Willd. (all included by Linnæus in his genus *Filago*), *uliginosum* L., *minimum* Sm., *fuscum* Scop., *pusillum* Hænke Sudet., *supinum* L., *multicaule* Willd., *americanum* Sw., *verticillatum* Thunb., *sylvaticum* L., *purpureum* L., *obtusifolium* L., *undulatum* L., *sanguineum* L., *luteo album* L., *affine* Fl. Nepal., *Busua* Fl. Nepal., *fœtidum* L. *japonicum* Thunb., *polycephalum* Mich., *Lagopus* Willd.

Addendum to Dr GREVILLE'S *Article, p.* 483.

THE moss described under the name of *Neckera Americana* I have, since the article was printed, found to be previously described. It is the *Neckera minor* of SCHWÆGR. Suppl. i. 2. p. 149, and the var. β of *N. viticulosa*, HEDW. Sp. p. 210. The reader is therefore requested to substitute the specific name of *minor* for that of *Americana;* though it is unaccountable how I could pass this over when describing the moss, yet the fact may serve to confirm the species, which appears to be very distinct, notwithstanding its great affinity with *N. viticulosa.*

APPENDIX.

HISTORY

OF THE

SOCIETY

(Continued from Vol. IV. p. 585.)

1823. May 31.

THE Secretary read a memoir on the Geographical Distribution of Plants in Yorkshire, by Mr Atkinson; also, a Biographical Notice of Mary Noble of Penrith, in the 107th year of her age; with some Remarks on Longevity, by Dr Thomas Barnes: and a Description of a New Species of Regulus from Brazil, accompanied with a Drawing, by Dr Traill. Professor Jameson then read the Reverend H. F. Borgesen's Description of Vettie's Giel, a striking scène in Norway.

June 14.

The Secretary read, 1*st*, The Continuation of Dr Fleming's Voyage round the North of Scotland, in 1821; 2*d*, Notice regarding the Migration of the Woodcock, by Major Morrison; 3*d*, The first part of a Paper on the power possessed by some species of Spiders of ascending into the air, by Mr John Murray, F. L. S., Lecturer on Chemistry.

There were then communicated to the Society the Results of a Series of Thermometrical Observations, made hourly at Leith, during twenty-four successive hours, once every month, from July 1822 to July 1823, by Mr Coldstream. Professor Jameson communicated Dr Boué's answer to M. Beudant's opinion regarding the Crystalline Rocks of the Red-sandstone formation, as explained in the 3d volume of his *Voyages en Hongrie;* also the first part of Dr Francis Hamilton's Commentary on the Herbarium Amboinense.

1823. Nov. 15. The Secretary read a paper by the Reverend Mr Dunbar of Applegarth, confirming Shirach and Huber's doctrine of the occasional conversion of the larvæ of working bees into queen bees: also, a Notice from Dr Cumin of Glasgow, regarding the Formation of Young Tubers within the substance of a large Potato, with the original specimen, and a Drawing of it by Mr P. Syme. Dr Knox then gave an account of the Foramen centrale of Sœmmering, as discovered by him in the Eyes of certain Reptiles, illustrating his communication by anatomical preparations. The Secretary read Extracts from a Paper by Mr Marshall, on the Natural and Economical History of the Cocoa Nut-tree. Mr Parry exhibited to the meeting Colonel Miller's newly invented Percussion-Shell, and gave an account of some successful experiments made with it near Leith Fort. Mr Nicol repeated, in presence of the meeting, Döbereiner's remarkable experiment, shewing the ignition of the fine powder of platina, when exposed to a stream of hydrogen gas in atmospheric air.

1823. Nov. 29. Dr Knox read a Paper on the Organs of Digestion, Respiration, and Circulation, of the Ornithorynchus paradoxus, illustrating his description by stuffed specimens and a natu-

ral skeleton. The Secretary read the concluding part of Dr Fleming's Gleanings of Natural History, on a Voyage round the North of Scotland, in 1821: also a Notice of Remarkable Hailstones, of a pyramidal form, which fell in Aberdeen in June last, by Mr Robert Lindsay of Aberdeen. Mr Parry exhibited some Drawings made from carvings in oak, executed before the time of Henry VIII: and Professor Jameson laid before the meeting a chart, shewing the route pursued by Captain Parry through various parts of Baffin's Bay, during the three preceding summers.

1823, Dec. 13. Dr Knox read a Paper on the Kidneys, Urinary Bladder, and Organs of Generation in the Male of the Ornithorynchus paradoxus, illustrating his descriptions by Sketches. Dr Yule gave an Account of the Changes produced on some Tallow Candles, which had been accidentally preserved in a dry state for near a century; and exhibited specimens. Mr Greville then read an Account of Mr Cormack's Journey across Newfoundland in 1822; and a short Paper narrating an instance of misdirected instinct in the common Frog, during the coupling season, communicated by Mr Burd. Professor Jameson gave an Account of Thermometrical and Hygrometrical Observations made at Port Callao, in South America, by Mr William Jameson, surgeon; and also read Extracts from a Letter, written from Funcal, by Mr Bowdich, the African traveller.

Dec. 27. Mr Greville read an Account of a Steinbart or Stone-axe, said to have been found imbedded in a layer of compact clay, under several beds of limestone, in Staffordshire; with Remarks on the geological consequences of this fact, if ascertained to be correct. Dr Knox read some Account of the

Quadrupeds met with on the Shores of the Inlets of Hudson's Bay, in Captain Parry's last Voyage, communicated by Dr Richardson.

1824. Jan. 10. Dr Richardson read the first part of an Account of the Animals collected and seen during the Overland Arctic Expedition, illustrating his remarks by shewing prepared Specimens of the Animals. Mr Arnott communicated a Paper by himself on some Species of Mosses.

Jan. 24. Dr Richardson read the concluding part of his Account of Animals collected during the Overland Arctic Expedition, and exhibited Specimens. Dr Knox read a Paper on the mode of Growth, Reproduction, and Structure of the Poison-fangs of Serpents, illustrating his description by Preserved Specimens, Anatomical Preparations, and Sketches. Mr Menteath of Closeburn presented a Specimen of a Larch Plank, shewing the manner in which the Larch Tree begins to decay at the base of the trunk, when twenty or thirty years old, if planted over sandstone.

Feb. 7. Professor Jameson read the introductory part of a Monograph on the genus Larus, by Mr Macgillivray; specimens of six of the species described were exhibited. The Secretary read an Account, contained in a letter to Professor Jameson, from Lieutenant Lamont, of the 91st Regiment, of the capture, in the West Indies, of an enormous Ray, popularly called the "Sea Devil," measuring fifteen feet in breadth, and almost as much in length. Dr Grierson of Cockpen read his General Observations on Geology, Geognosy, Oryctognosy, and Mineralogy, and on the Nature of these respective Studies.

1824. Feb. 21. Dr Knox read a Memoir on the Osseous, Muscular, and Nervous Systems of the Ornithorynchus paradoxus, illustrating his description of the osseous structure by a perfect skeleton of the animal. The Secretary read a deposition by three Shetland fishermen, Daniel and William Manson, and John Henderson, emitted on oath before Arthur Nicholson, Esq. of Lochend, Justice of the Peace, relative to a small cetaceous animal, of very uncommon appearance, which they had accidentally captured at the deep sea fishing, and taken into their boat, but soon afterwards released, from superstitious feelings, they having believed it to be a mermaid.

Mar. 6. Professor Jameson read an Account of Petrified Shells found in the Gawilghur range of hills, and of the Structure of the Hill of Seetabuldee-Nagpoor, in the East Indies, by Mr Vaysey. A live Rattle-snake, newly arrived from South Carolina, and in a vigorous state, was exhibited to the meeting. Mr Parry read the first part of his Paper on the Management of Young Plantations, recommending, in the fir tribe, the practice of disbudding with the thumb, at a very early period, instead of pruning with the knife and saw at later times.

Mar. 20. The Secretary read the second part of a Paper by Mr John Murray, F. L. S., on the Ascent of some species of Spiders into the air, shewing that this depends on their fine gossamer threads being peculiarly affected by the electric fluid of the atmosphere. Also two Papers by the Rev. Dr Fleming of Flisk; the one containing an Account of a New British Species of Spatangus; and the other a Description of a New Species of Plumularia, collected in the late expedition under Captain Parry; with some Remarks on the

Sertulariadæ found in Hudson's Straits. Mr Arnott then read a communication from Prideaux John Selby, Esq. of Twizel House, containing some curious particulars in the Natural History of the Golden Regulus.

1824. April 3. Mr Parry read a continuation of Notices regarding the Management of Young Plantations. Dr Knox then communicated some Remarks on the supposed Discoveries of Professor Tiedemann, and Dr Fohmann, relative to the non-existence, in the Phoca vitulina, of the *vasa efferentia*.

April 17. Dr Knox read a short Paper on the Colymbus septentrionalis, or Red-throated Diver, shewing that the bones are black or dark-coloured, and that this coloration depends on the periosteum. Mr Deuchar communicated some Remarks on Meteoric Stones, and proposed a theory to account for their formation. At the same meeting, there was laid before the Society the first part of a Memoir on the Sandfield in the vicinity of Edinburgh, by Mr Alexander Blackadder.

May 1. The Secretary read a communication sent to the Society, entitled, Observations and Experiments on the Formation of Pearls. Also, Notice of a Substitute for Cork, in Tropical Climates, being the central part of the scape of Agave vivipara; by the Reverend Lansdown Guilding of St Vincent; with Specimens of the Prepared Agave-Cork. And likewise an Account of William Dempster, who accidentally swallowed a large Table-knife, at Carlisle in November last, by Dr Barnes of Carlisle. Professor Jameson read a Notice of the Discovery of some Fossil Remains of a Whale found near the seat of Lord Dunmore, on the banks of the

Forth, and at several hundred yards distance from the present bed of the river; communicated by Mr Alexander Blackadder, Allan-Park. A stuffed specimen of the Dog of New South Wales, presented to the Museum by Governor Brisbane, was then exhibited, and described by Professor Jameson.

1824. May 15. Professor Jameson communicated Mr A. Blackadder's Observations on the Alluvial Strata of the Forth District, illustrated by a Geognostical Map. Mr Witham of Lartington read a Memoir on some peculiarities existing in the Trap Rocks in the west and north-west of the counties of York, Durham, Westmoreland, and Northumberland. The Secretary read a Notice regarding the Pernicious Effects on Fruit-trees, of the layer of bog-iron-ore immediately under the surface-soil in Aberdeenshire, provincially termed *pan*; communicated by Mr Stevenson, Civil-Engineer. Mr F. A. Parry exhibited a remarkable stalagmite or deposition formed at the bottom of one of the tanks of lime-water at Canongate of Edinburgh, through which the coal-gas is passed with a view to its purification. Mr Deuchar then communicated his view of the comparative merits of the different Theories of Galvanic Action.

Nov. 13. The Secretary read, 1*st*, A Notice of the incarceration of a live Toad (*Rana verrucosa*) in the wall of Fort-William Barracks, Calcutta, for the period of fifty-four years; communicated by Major-General Hardwick; 2*d*, Account of the Monocotyledonous and Acotyledonous Plants found between the 4th and 11th degrees of north latitude, on the western coast of Africa; by Mr George Don; 3*d*, Notice of a viviparous variety of Juncus lampocarpus; communicated by Mr Parry.

1824. Dec. 4. The Secretary read two communications relative to the discovery of the Bones of a Grampus or Small Whale, in the carse-clay, lying over black peat-moss, on the estate of Blair Drummond; the one communication by Henry Home Drummond, Esq. M. P., and the other from Mr A. Blackadder, surveyor. There were likewise laid before the meeting, Meteorological Observations made at Guayaquil, from January to June 1824, by William Jameson, Esq. surgeon; and Barometrical Observations between the Pacific Ocean and Mendoza, in the year 1821, by Dr Gillies. Dr Barclay presented a letter from Dr Mease of Philadelphia, accompanying a specimen of the Siren lacertina, for the Society's collection.

Dec. 18. The Secretary read, 1*st*, A communication from Dr Treviranus of Bremen, on the Cochlea of the Internal Ear of Birds; 2*d*, A Notice by Mr J. W. Reddoch of Falkirk, regarding the Bones of a Quadruped, found in a bed of clay, and of razor-shells found in a bed of sand under the clay, near Camelon, ninety feet above the present level of the Forth; 3*d*, The description, by Dr Traill of Liverpool, of a New Species of Silurus, S. Parkeri, found in the river at Demerara, in 1821.

1825. Jan. 8. Dr Knox read a short communication, shewing that the bones found in a bed of clay near Camelon, and ninety feet above the present level of the Forth, were those of a full grown seal, of the species still inhabiting the Frith of Forth. The first part of Dr Richardson's Remarks on the Climate and Vegetable Productions of the Hudson's Bay Countries, was then read.

Jan. 22. The Secretary read Dr Richardson's Observations on the

Climate at Fort Enterprize, Lat. 64° 28′ N., Long. 116° 6′ W.; with an Account of the Progress of Spring and Summer, at that station, in the year 1821. Dr Greville read extracts from, and gave a general account of, the third memoir, by himself and Mr Arnott, on a New Arrangement of the Musci. The Secretary then read an Account of a New Species of Ornithorynchus (O. crispus), by Mr Macgillivray; specimens of this, and the other species, being, at the same time, placed on the table. Professor Jameson gave an Account of the Sea-Leopard; an animal of the genus Phoca, from the lately discovered islands of New South Orkney; and of the Eared Seal from New South Shetland; both animals brought home by Captain Weddel.

1825. Feb. 5. The Secretary read the concluding part of Dr Richardson's Observations on the Botany of the Hudson's Bay Countries. Mr Witham read a Notice of the occurrence, in Primitive rocks, in Ross-shire, of Mineral Pitch, which has hitherto been observed associated only with secondary rocks; specimens were also laid upon the table. The Secretary read Mr John Baird's Account of Fossil Trees, found in Secondary Trap-rocks, at Cleghorn, in Lanarkshire; and specimens were likewise produced. Professor Jameson read a communication from Mr A. Blackadder, Allan Park, tending to shew that the Rhinoceros Horns of Blair-Drummond may probably be regarded as having occurred in the blue clay of that district. Professor Jameson also read an Account, communicated by Mr David Mylne, of some remarkable Fossilized Trunks and Branches of Trees, found in a quarry near Coldstream; and fine Specimens of these were exhibited. Mr David Blackadder, of Edinburgh, laid before the meeting samples from Blair-Drummond Moss, 1*st*, Of the peat beneath the blue clay; 2*d*, Of the clay itself; and, 3*d*, Of the surface peat.

1825. Feb. 19. The Secretary gave a General Account, 1*st*, Of Tables of Summer Temperature observed in Spitzbergen, by Captain Franklin and Captain Buchan; and, 2*dly*, Of a Table of the Temperature of the Sea, at various depths, made during Capt. Franklin's voyage to Spitzbergen. There was then read a Notice in regard to the Fossil Trees, &c. found imbedded in the clay strata near Harwich, contained in a letter from Mr William Knott, Landguard Fort; and a specimen of the fossil wood was exhibited. Likewise a Notice in regard to a collection of Buried Trees, apparently native kinds, lately found in draining a peat-moss in West Lothian; in a letter from Mr Logan of Clarkstone to Mr A. Blackadder. Observations made during a voyage to the East Indies and China, in 1817 and 1818, by Captain Charles Stewart of the Honourable East India Company's ship General Harris, were laid on the table. Professor Jameson gave an Account of a Specimen of a Large Fossil Tree lately dug out of the Coal Formation at Cullalo, in Fyfe, which was exhibited to the meeting. Dr Grant then read the first part of a Memoir containing a series of Observations and Experiments on the Natural History of Sponges, which he illustrated by Specimens.

Mar. 5. Professor Jameson read the Reverend George Young's Account of the remains of a genuine though extinct species of Crocodile, 18 feet long, lately found imbedded in the secondary rocks at Whitby in Yorkshire; and, at the same time, exhibited a correct Drawing of it, executed by Mr Bird. Dr Grant read the conclusion of his first Memoir, containing a series of Observations and Experiments on the Natural History of Sponges. A fine Specimen of Organic Vegetable Remains, found in Craig-Leith quarry, was exhibited and described by Professor Jameson.

1825. Mar. 19. The Secretary read a Notice of the effects produced by the presence of the Larva of an Insect in the Human Stomach; communicated by Dr Yule. He then gave an Account of Mr George Cheyne's Journal from Madeira to Lat. 18° 06′ N. and Long. 38° 20′ W., and presented to the meeting a commentary on the Second Book of the Herbarium Amboinense, by Dr Francis Hamilton. A letter from Mr James Fotheringham, Gairny Bridge, was then read, giving a general Account of the Shower of Fishes supposed to have fallen in the west of Fifeshire last summer. Mr Deuchar exhibited a very singular experiment with compressed inflammable gas; and likewise the application of Mr Gordon's portable lamp apparatus as a blowpipe.

April 2. The Secretary read a Notice regarding Specimens of Peat Moss, of different qualities and densities, from a moss at Jardine-Hall, Dumfries-shire. Likewise a short Notice regarding the Magnetism of the Earth, by the late Lieutenant Mathew Miller; which Mr Adie illustrated by an experiment, shewing the effect of Magnetic Bars, placed with N. and S. ends together, upon a compass passed over them. Professor Jameson read an Account of the recent discovery of a Tusk of the Mammoth, in a bed of old alluvium, containing also Marine Shells, and situated near to Kilmarnock, in Ayrshire. Dr Grant then read an Account of a Particular Organ, observed by him in the cuttle-fish (Sepia loligo), and which he regards as analogous to the pancreas: Specimens were also laid on the table.

April 16. There was laid before the meeting a Description and Drawing of a Species of Cephalus, nearly allied to Tetrodon truncatus of Cuvier; communicated by Dr Traill of Liverpool. Professor Jameson communicated to the So-

ciety Mr David Mylne's Descriptive Account of the Stratification on the right bank of the Whitadder. Dr Grierson of Cockpen read his Account of the Explosion of Stobbs Gunpowder Mills, on the 17th of February last: And the Secretary read a short Additional Notice by Mr Hutcheson of Dalkeith Mills, communicated by Mr Burd. The Secretary then read Mr Alexander Blackadder's Report regarding the Buried Forest of Lawrence Park, near Linlithgow. Mr Deuchar communicated his Observations on Magnetic stimuli; illustrating some of his remarks by repeating several of Professor Oersted's experiments. There were exhibited by Professor Jameson to the meeting, 1*st*, The cast of a remarkable and supposed Antediluvian Skull; 2*dly*, The cast of a Jaw-bone of the Mammoth,—both from the Great Valley of Austria; 3*dly*, Two Specimens of the Ancient Bricks of Babylon, containing inscriptions in an unknown character.

1825. April 30. Dr Grant read a Paper on the Existence of a Pancreas in Gasteropodous Animals, and shewed dissected Specimens of the Doris Argo, with the pancreas pointed out. The Secretary then read a communication from Mr Blackadder, staff-assistant surgeon, on Unusual Atmospherical Refraction, or Misage, as observed in this neighbourhood; and laid before the meeting some Account of Capt. Franklin's Trigonometrical Observations made in India. Dr Greville gave an Account of Two New Species of Musci, of the genera Neckera and Hypnum.

May 14. Mr Haidinger read a Paper on Drawing the Figures of Crystals in True Perspective. The Secretary read Mr Blackadder's Account of the Luminous Arch which lately accompanied the appearance of the Aurora Borealis at

Edinburgh. Dr Knox exhibited Bones of Various Animals, found in the Caves of Oreston, near Plymouth, being chiefly bones of large oxen and very large deer. A letter from Henry Home Drummond, Esq. M. P. was then read, accompanied by a plug of wood, which was found inserted in a circular perforation existing in the great stag's horn discovered in the Blair-Drummond peat moss, and which would intimate that the stag had been in the hands of the former inhabitants of the district. Professor Jameson gave a general account of a long communication received from a correspondent, on the chances for and against Captain Parry's succeeding in his present attempt to reach the South Sea, by Icy Cape; the opinions of the author being unfavourable to his success. He also exhibited the tusk of the Fossil Elephant or Mammoth lately found near Kilmarnock.

1825. Nov. 19

Mr Witham read a Notice of the occurrence of the Common Cockle (Cardium edule) in a living state, in Fresh Water Ditches, at Cocklesbury, in Yorkshire, at a great distance from the sea, and much above its present level. A Memoir by Mr David Don, on the Classification of the genera Gnaphalium and Xeranthemum of Linnæus, was laid on the table. There was then read the first part of a sketch of the Comparative Anatomy of the Organ of Hearing, containing Remarks on the Structure of the Ear in the Shark-tribe, illustrated by Preserved Specimens; by Mr Thomas Buchanan. There was next read a communication regarding the existence of a Rock of Conglomerate in the Gravel Beds near Edinburgh; and Specimens of the rock were exhibited. Professor Jameson gave an Account of a Table of Colours, arranged for Naturalists, by the Reverend Lansdown Guilding of St Vincent's.

1825. Dec. 3. The Secretary read Dr Traill's Remarks on the Anatomy of the Trumpeter Bird, Psophia crepitans. Dr Grant then made some Observations on the Habits of the Tritonia arborescens, particularly the power possessed by that animal of producing a peculiar and very audible sound; and at the same time exhibited living Specimens. Prof. Jameson communicated some Remarks on the existence of many Mineral Substances, in very minute quantities, in the Ocean and in the Atmosphere. He then laid before the meeting a Letter from Count Sternberg, accompanied with a New Fasciculus of his Work on Fossil Remains of Plants. And the Secretary read a Letter from Dr J. Miller of Kingston, Jamaica, expressing the wish of the Agricultural Society of Jamaica to correspond with the Wernerian Society; to which the Secretary was authorised to reply, assuring the Jamaica Society that it will afford this Society much satisfaction to be able, in any way, to promote the objects of the Jamaica Institution.

Dec. 17. The Secretary read a Paper by Mr John Murray, Lecturer on Chemistry, containing Experiments and Observations on the varying Temperature of the Chameleon, as connected with the Changes of Colour exhibited by the animal. Professor Jameson communicated a Notice of Zircon found in Primitive Rocks in the Island of Scalpay, Harris; by Mr William Nicol, Lecturer on Natural Philosophy. The Secretary then read a Notice by Mr P. J. Selby, regarding a specimen of the rare Larus minutus, shot in Galloway, and sent to the Museum by Lieutenant Macculloch, Barholm House. Likewise a communication from Dr Traill regarding the use of Oil of Turpentine for preserving Zoological Specimens in Cabinets: This substance, it was stated by Professor Jameson, had been em-

ployed, for several years past, in the Museum here, with the same view, and with great success. Professor Jameson then read the first part of Mr William Macgillivray's Account of the Animals of the classes Cirripeda, Conchifera, and Mollusca, observed in the Island of Harris. And he also communicated a Letter from Mr Meynell, of Yarm, in Yorkshire, mentioning that he had, for four years past, kept the smelt or spirling (Salmo Eperlanus, LIN.), in a fresh-water pond, having no communication with the sea, by means of the Tees, or otherwise, and that the smelts had continued to thrive, and breed as freely, as when they enjoy intercourse with the sea.

OFFICE-BEARERS, 1826.

Office-bearers elected at the Meeting on 3d December 1825.

President,

ROBERT JAMESON, Esq. Prof. Nat. Hist. Edin. &c.

Vice-Presidents,

ROBERT BALD, Esq.	Dr ROBERT GRAHAM,
Sir WM. JARDINE, Bart.	Rev. Dr BRUNTON.

Secretary, PATRICK NEILL, Esq.
Treasurer, A. G. ELLIS, Esq.
Librarian, JAMES WILSON, Esq.
Painter, P. SYME, Esq.

Council.

WILLIAM DRYSDALE, Esq.	Dr ANDREW COVENTRY.
GILBERT INNES, Esq.	JOHN STARK, Esq.
Dr ROBERT KNOX.	Dr R. E. GRANT.
G. A. W. ARNOTT, Esq.	Dr JOHN BOGGIE.

List of Members of the Wernerian Natural History Society of Edinburgh,—continued from Vol. IV.

RESIDENT.

1823.

Nov. 29. JOHN ALEXANDER CAMERON, Esq. Edinburgh.
HENRY WITHAM, Esq. of Lartington.
EDWARD WILLIAM AURIOL HAY, Esq. A. B. Oxon.
The Rev. ALEXANDER BRUNTON, D. D. Professor of Oriental Languages in the University of Edinburgh.

1824.

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CHARLES MACALISTER, Esq.
JOHN WILSON ANDERSON, Esq.
WILLIAM DUNLOP, Esq. Surgeon, and Lecturer on Forensic Medicine.

April 3. JAMES SYME, Esq. Surgeon, and Lecturer on Anatomy, Edinburgh.

1825.

Feb. 5. HENRY ENGLEFIELD, Esq.
WILLIAM GIBSON THOMSON, Esq.

CORRESPONDING.

1823.

Nov. 29. Mr WILLIAM MACGILLIVRAY, Edinburgh.

1824.

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THOMAS HORTON JAMES, Esq. London.

May 15. THOMAS BARNES, M. D. Carlisle.

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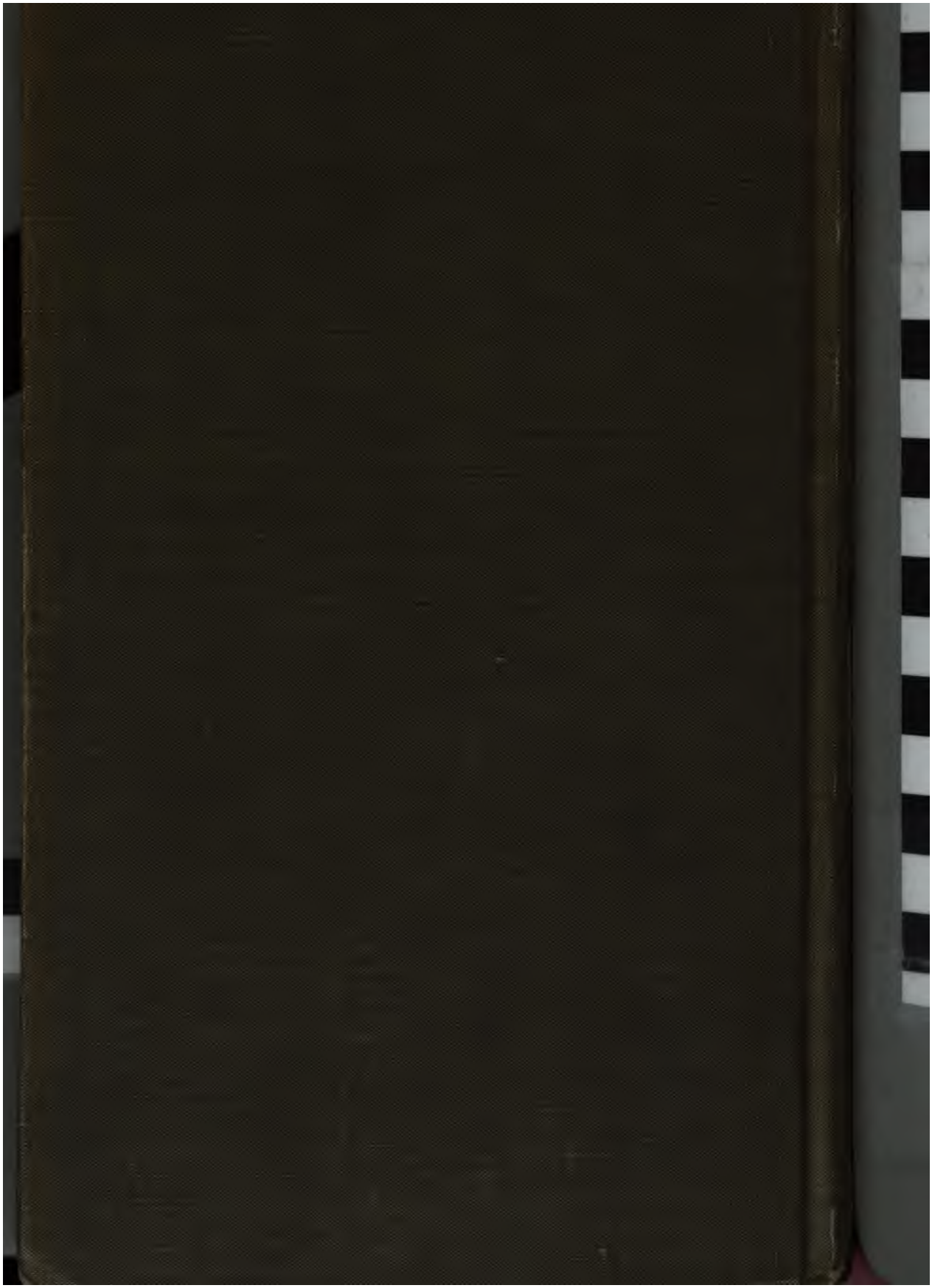
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